Exhibit 1

THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

Nemet, et al.

V.

Volkswagen Group of America

CASE NO. 3:17-CV-04372

Expert Report of Peter E. Rossi

1. Qualifications

1. I am the James Collins Professor of Marketing, Statistics and Economics at the Anderson School of Management, UCLA. I hold a joint appointment in the Anderson School and the Economics Department. I received my BA in 1976 from Oberlin College with a double major in mathematics and history. My graduate degrees are from University of Chicago (MBA (1980) and PhD (1984)). I received my PhD in Econometrics which is the science of the application of statistical methods to economic data. During my doctoral training, I completed a wide variety of courses in sampling theory, statistics, econometrics, and economics.

2. My first faculty appointment was at the Kellogg Graduate School of Management where I served as assistant professor of Managerial Economics. In 1985, I moved to the University of Chicago's Booth School of Business where I was appointed as assistant professor of econometrics and statistics. In 1994, I was promoted to Professor of Econometrics and Marketing. In 1996, I received an endowed chair. At the University of Chicago, I taught both masters and doctoral courses in statistics, market research, econometrics and economics. In 2009, I joined the Anderson School of Management as the Collins Distinguished Professor. At Anderson, I have taught both doctoral and masters' levels courses in Econometrics, Bayesian Statistics, New Product Development, and Data Analytics.

3. In Appendix A, I provide my Curriculum Vitae. I have authored over 65 refereed publications in leading journals in Statistics, Economics, Econometrics, and Marketing. I am the author of books published by John Wiley and Sons and Princeton University Press. My published research has received wide attention as evidenced by more than 18,000 citations on Google Scholar. I have been elected fellow of the American Statistical

Association, the Journal of Econometrics, and the INFORMS Society of Marketing in partial recognition for my research contributions. My doctoral students are on the faculties of many leading research universities including The Ohio State University, Carnegie Mellon University, and the University of Rochester. I am senior editor of Marketing Science and founding editor of Quantitative Marketing and Economics (QME). These are two of the top three journals in the area of quantitative marketing. I have also provided the list of my prior testimony in Appendix B and a list of the materials I have considered in Appendix C.

4. I developed Bayesian methods appropriate for marketing data, including choice-based conjoint. The most widely used methods for conjoint analysis, Hierarchical Bayesian Choice-Based Conjoint,[1] were developed by my student Greg Allenby, and then extended by both Professor Allenby and myself, working together and independently. I have written the bayesm R package, which is used worldwide to analyze conjoint data. I have also authored two recent articles on the valuation of product features of the sort considered in this matter.[2] In addition, I have co-authored an article on the economic foundations of conjoint for the definitive reference handbook, The Handbook of the Economics of Marketing.[3] I have also served as an expert in a number of cases involving conjoint surveys including *In re: General Motors LLC Ignition Switch Litigation, Riley Johannessohn et al. v. Polaris Industries, Inc.,* and *Paul Stockinger et al. v. Toyota Motor Sales, USA, Inc.*[4]

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[1] Rossi, P. E., G. M. Allenby, and R. McCulloch (2005), *Bayesian Statistics and Marketing*, England: John Wiley & Sons, Ltd.

[2] Allenby, G. M. et al. (2014), "Economic Valuation of Product Features," *Quantitative Marketing and Economics* 12, 4, 421–456; Allenby, G. M. et al. (2014), "Valuation of Patented Product Features," *Journal of Law and Economics* 57, 3, 629–663.

[3] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192.

[4] *In re GM LLC Ignition Switch Litigation,* US District Court, Southern District of New York, Case No. 14-MD-2543 (JMF); *Riley Johannessohn et al. v. Polaris Industries, Inc.,* U.S. District Court, District of Minnesota, Case No.

2. Assignment

5. I have been asked to review and respond to the reports and opinions of Steven Gaskin and Colin Weir. Mr. Gaskin has sponsored a conjoint survey and willingness to pay calculations as a basis for damage calculations by Mr. Weir. Mr. Weir's damage calculations are based solely on a conjoint survey conducted and analyzed by Mr. Gaskin. The Gaskin consumer survey estimates the change in willingness to pay for certain diesel vehicles ("TDI vehicles" or "vehicles") that a disclosure of the "defeat device"[5] might create, which Mr. Gaskin treats as equivalent to determining the market price for the "but for" universe in which disclosure took place. Mr. Weir simply takes this change in willingness to pay (expressed as a percentage) and multiplies the price paid by Plaintiffs by this percentage to provide a damages estimate. Mr. Weir also offers what he calls an "offset" method of damages, which attempts to reckon with the problem created by the resale of vehicles by Plaintiffs prior to disclosure of the "defeat device."

6. I am compensated for my work in this matter at the rate of $1,250/hour.

3. Summary of Opinions

7. It is my opinion that the opinions and analyses offered by Mr. Gaskin and Mr. Weir are unreliable for the following reasons:

0-16-cv-033348-NEB-LIB; *Paul Stockinger et al. v. Toyota Motor Sales, USA, Inc.,* US District Court, Central District of California, Case No. 17-CV-00035-VAP-KS.

[5] I understand that TDI vehicles at issue in this case were equipped with certain lines of code contained in the software of the electronic control module (the "defeat device") that had the impact of limiting nitrogen oxide ("NOx") emissions when tested on a standard dynamometer, a device used to test vehicles for compliance with regulations issued by the United States Environmental Protection Agency ("EPA") and the California Air Resources Board ("CARB").

a) Mr. Weir endorses a theory that Plaintiffs overpaid for their vehicles due to a failure to disclose that the vehicles were equipped with a "defeat device" which could result in emissions that do not meet EPA standards. He claims that if "overpayment" occurred at the "time and point of sale" that the "Plaintiffs incur the totality of the harm caused by Defendant (sic)."[6] Mr. Weir makes this claim in spite of the fact that all Plaintiffs in this case disposed of their vehicles prior to public (and hence market) knowledge of the "defeat device."[7] From an economic standpoint, absent any evidence to the contrary, this means that whatever overpayment occurred at the point of sale would be fully recovered if a Plaintiff sells their vehicle.[8]

b) Mr. Weir offers an alternative "offset" theory of damages in which Plaintiffs would, despite having resold their vehicles, be allowed to recover a portion of the "overpayment" price premium that Mr. Weir asserts exists. Mr. Weir offers this "offset" theory without an economic explanation or justification. As I discuss below, Mr. Weir implicitly endorses a view that a portion of the overpayment has "depreciated" over the life of the vehicle, but he has failed to show that any alleged overpayment tied to a misleading statement or omission regarding emissions or emissions compliance, if it existed, is subject to depreciation at all, unlike other aspects of a vehicle which are subject to wear (e.g. brakes and powertrain).

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[6] Declaration of Colin B. Weir and supporting materials, February 14, 2020 ("Weir Report"), ¶¶ 50, 53.

[7] First Amended Class Action Complaint, *Jennifer Nemet et al., v. Volkswagen Group of America, Inc. et al.*, Docket No. 3:17-CV-04372-CRB, November 2, 2018 ("Complaint"), ¶¶ 4–8.

[8] Similarly, Plaintiffs who leased and returned their vehicles before the public knowledge of the misconduct would not have suffered losses. There is no reason to believe that both the initial value and the "residual" value of a leased vehicle would not be both inflated by absence of market knowledge of the "defeat device." Thus, Mr. Weir has not explained why it is appropriate to assert that there is any economic loss in the case of a lease.

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c) Mr. Gaskin surveys only new vehicles and explicitly states that his survey is not applicable to used vehicles, directly contradicting Mr. Weir's use of survey results in his "offset" analysis in which he applies a willingness to pay differential to used car prices.

d) Mr. Weir uses the analysis from Mr. Gaskin's conjoint survey as the sole basis for a measure of "overpayment." A conjoint survey, no matter how well conducted, only measures consumer demand for products and cannot be used to calculate an amount of "overpayment," as incorrectly alleged by both Mr. Gaskin and Mr. Weir because it does not measure supply-side factors that are necessary to calculate a market price. Instead, Mr. Gaskin calculates an average Willingness To Pay ("WTP") as a measure of damages. It is well known that WTP is not equal to a market price and will overstate damages.

e) A valid economic measure of "overpayment" would be the difference in market price between vehicles as represented and the vehicles received by Plaintiffs. The Plaintiffs allege that the market price of the vehicles at issue would have been lower had the "defeat device" been disclosed. Mr. Gaskin and Mr. Weir have not calculated and cannot calculate a market price in the world in which the presence of the "defeat device" is known.

f) Mr. Gaskin's "market simulations" are not market simulations at all but simply predicted sales from a conjoint model. Mr. Gaskin makes the further error of assuming in his "simulations" that only two Volkswagen products are available in what he believes is the "marketplace." Mr. Gaskin does not even consider competing products in his "market simulations."

g) Mr. Weir's arguments that if the prices used in the eventual conjoint are informed by MSRPs for the relevant vehicles, then Mr. Gaskin's analysis can deliver a market price or value are incorrect and runs contrary to basic economic principles.

h) Mr. Gaskin's conjoint survey does not isolate the effect of compliance with EPA emissions alone on willingness to pay for vehicles. His questionnaire defines the key attribute to include not only lack of compliance with emissions standards but also other possibilities, like an unspecified degradation of "fuel economy and performance."[9] This biases the WTP calculation in favor of the Plaintiffs.

i) Mr. Gaskin screens so that his sample includes owners of both gasoline- and diesel-powered vehicles, even though the Plaintiffs only allege the "defeat device" was present in specific vehicles with diesel engines.

j) Even beyond the screening issue, Mr. Gaskin did not follow accepted survey practices in designing and administering his conjoint survey. In particular, Mr. Gaskin did no primary qualitative research, uses an inadequate sample size, and says nothing regarding sample representativeness. Mr. Gaskin's sample is demonstrably non-representative with a majority of female respondents, contrary to research showing the vast majority of diesel owners are male.

k) Mr. Gaskin applies a conjoint survey outside of the domain for which this technique was developed without any reference, assurance or argument as to how conjoint might apply to this situation involving product defects or aspects of product performance not available at the point of purchase.

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[9] Expert Report of Steven P. Gaskin, February 14, 2020 ("Gaskin Report"), p. 19.

l)   Neither Mr. Weir nor Mr. Gaskin can provide any measure of the margin of statistical error in their damages estimates, rendering the estimates unreliable as a matter of accepted methodologies.

4. The Gaskin-Weir Approach Does Not Match Plaintiffs' Theory of Damages

8.   Plaintiffs contend[10] that VW[11] sold vehicles without disclosure of a "defeat device." Plaintiffs further contend that purchasers of certain VW and Audi diesel powered vehicles obtained vehicles whose emissions did not meet EPA standards.

> "Class members certainly would not have paid a premium for this purportedly "clean diesel" engine had they known the vehicles' true characteristics. The existence of this premium is supported at a minimum by the difference between what consumers paid for their TDI "clean diesel" vehicles and what they would have paid for their gasoline counterparts."[12]

9.   All named Plaintiffs in this matter disposed of their vehicles prior to the disclosure by VW that a "defeat device" existed and therefore that their vehicles may not meet EPA emissions standards. Standard economic principles would assume (absent contrary evidence) that a premium (if any) for a certain level of emissions or emissions compliance with EPA standards would be recovered at the point of resale of the vehicles as the market is not yet aware of a "defeat device."[13] For example, if I were to purchase a fraudulent Warriors basketball game ticket on Craigslist and sold that ticket prior to anyone discovering that the ticket is actually only valid for inferior seats, I have not been injured from an economic point of view. Similarly, if I use the fraudulent ticket to attend the Warriors game in my preferred seat without incident, I have not been harmed. On the

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[10] Complaint, Section H, ¶¶ 503–512.

[11] Plaintiffs allege that these vehicles were sold or leased by Volkswagen AG, Volkswagen Group of America, Inc., Audi AG, and Audi of America, LLC (which they define collectively as "VW"). Without agreeing with Plaintiffs' grouping of Defendants, I similarly reference "VW" throughout my report.

[12] Complaint, ¶ 504.

[13] As explained above, for lessees, this recovery is already baked into the original calculation of lease payments because the expected "resale" price is included in the lease contract terms.

other hand, if it is discovered that my vendor from Craigslist is a fraud before attending

the game, then the resale value of the ticket falls and I have been injured by that fall in

price. This is the essence of any valid interpretation of an overpayment damages theory,

in which the economic harm consists of the difference between the market price for the

item as received and the market price of the item represented. In the case of the fraudulent

basketball ticket, the market price of the item as received and as represented is the same

until there is revelation that the ticket is fraudulent. The same principle applies here.

10. It should be emphasized that Mr. Weir provides no arguments to refute that whatever

"premium" was paid by Plaintiffs would be recovered when they sold their vehicles prior

to public disclosure of a "defeat device." In fact, Mr. Weir stakes out an economically

incoherent position that there was no recovery of a premium at all upon resale:

> "Because, by definition, Overpayment Damages are incurred at the time and point of
> first sale or lease, original purchasers and lessees … incur the *totality* of the harm
> caused by Defendant."[14]

Mr. Weir provides no references nor economic logic as the basis for his conclusion that

no amount of the "overpayment" could be recovered at the sale of the vehicles, and I am

aware of none. Economists would conclude that the premium would be recovered at the

point of sale.

11. In Section 6 below, I discuss Mr. Weir's "offset" calculation, which contradicts his

assertion that there should be no offset of any premium paid at the point where a plaintiff

resells the vehicle.[15] I also review the arguments articulated in the complaint regarding

possible "depreciation" of such a premium and explain why these have no foundation in

a proper economic analysis.

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[14] Weir Report, ¶ 53.
[15] Weir Report, ¶ 53.

12. Mr. Weir endorses a damages theory that does not allow for recovery of a price premium. For expositional purposes only, I will set aside my strong opposition to the notion that any damages at all occurred here (given that each Plaintiff resold his or her vehicle and recovered any premium). I now review Mr. Weir's damages methodology and show that even if one were willing to set aside the recovery of premium issue, Mr. Weir fails to provide any valid method for computing a price premium.

13. Mr. Weir's damages methods are based on an "overpayment" or "diminished value" theory in which class members paid more for their vehicles than they would have if the existence of the "defeat device" were known by consumers in the market. Neither Mr. Weir nor Mr. Gaskin is clear about what they mean by "market value."

14. Mr. Weir and Mr. Gaskin appear to endorse a theory of damages in which damages are based on the difference in "value" between the goods as represented and the goods as received. As a matter of economics, a proponent of this theory must provide a measure of this reduced "value" attributable only to the alleged "defeat device." As an economist and damages expert, the only meaningful, sensible, and logically defensible measure of value is a market price, defined (as discussed further below) as a computation of both supply and demand. Thus, for an "overpayment" or a price premium theory of damages to be economically valid, it must measure the difference between the market price actually paid by proposed class members for their TDI vehicles and the market price for those vehicles that would have prevailed if all consumers knew about the existence of the "defeat device." The validity of Mr. Gaskin's survey and Mr. Weir's damages calculations must be based on whether or not they reliably estimate the market price that would prevail with full disclosure, which would include calculating both demand and supply in a world with full disclosure—which they have not done. It should be noted that Mr. Weir and Mr.

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Gaskin misuse the term "market price" or "market value" to describe their results at many places in their reports. Appendix E enumerates the instances in the Gaskin and Weir reports where they use terms such as "market value" or "market price," even though their analysis does not compute a market price because of their failure to model supply and compute an equilibrium price.

15. I agree with Mr. Weir that the value of goods as represented is properly measured by the market price paid for these vehicles by class members. This is, however, not the difficult problem in damages assessment. The difficult problem is to assess the market price that would prevail after the "defeat device" was disclosed to the market place – namely, the price in what some call the "but-for" world in which existence of the "defeat device" was known. For example, consider a class member who purchased a VW Jetta sedan for $28,000. We know what market price was paid for that vehicle ($28,000). What we don't know is what the market price for that Jetta would have been if it were fully disclosed and widely known to consumers that this vehicle contained a "defeat device." This market price of the vehicle as received is not computed by Mr. Gaskin or Mr. Weir, nor can it be using their damages methodology.

16. In summary, an economically sound overpayment damages methodology must provide a valid way of assessing the price that would prevail in a world that never existed – the world where the "defeat device" is fully disclosed. Therefore, the Gaskin-Weir damages methodology should be judged on whether or not it is able to compute the market prices for the vehicles as received (under full disclosure). Mr. Gaskin and Mr. Weir do not provide a market price for the vehicles in the counterfactual "but-for" world; Mr. Gaskin instead uses the term "market value" in his report. I will demonstrate below that Mr. Gaskin does not and cannot compute the requisite market price. Since Mr. Weir's damage

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calculations are based entirely[16] on estimates provided by Mr. Gaskin, Mr. Weir cannot compute a market price for any vehicle. The only market prices that find their way into Mr. Gaskin and Mr. Weir's method are the prices paid by class members, which is only one half of a complete damages calculation.

17. Before explaining, in detail, why the Gaskin-Weir method fails to provide the key market price needed for an economically appropriate damages method, I explain how an economist should compute the reduction (if any) of market price that might occur if a product defect was fully disclosed.

18. It is useful to start with how the market prices are obtained. In basic economics, the idea is that a market price is determined by the intersection of the demand and supply curves. The demand curve shows the Willingness to Pay ("WTP") of consumers for a given product.

Figure 1: Demand and Supply Illustrated

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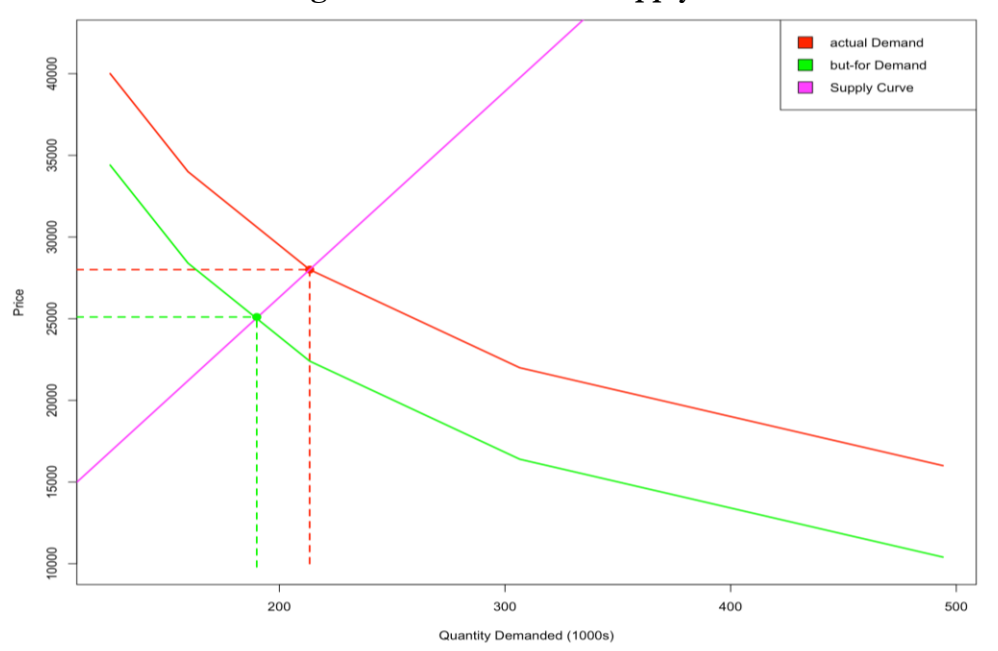
[16] It is also based on the number of vehicles purchased by proposed class members, but this has nothing to do with whether or not the Gaskin survey can compute a valid but-for price.

19. For example, the red, downward sloping curve in Figure 1 represents a demand curve for a specific vehicle for illustrative purposes. For each price along the horizontal axis, the curve shows how many consumers would purchase that vehicle at that price, with more consumers being willing to buy a vehicle as its price declines. For example, consider a price of $40,000. This is the highest price used in Mr. Gaskin's survey, and a relatively small number of consumers (much fewer than 200,000) would be willing to pay $40,000 for that vehicle. Clearly, if the price is lowered, more consumers would be willing to purchase the vehicle at the lowered price. This is why the demand curve slopes downward. It should be emphasized that the demand curve measures Willingness To Pay only. That is, consumers who might be willing to pay as much as $28,000 for the vehicle do not necessarily have to pay that amount unless the market price is set at $28,000.

20. How then is the market price determined? A market price will be the price at which Demand equals Supply. Just as the demand curve is defined by the Willingness To Pay of consumers, the supply curve shows how many units are supplied at any given price, with the number of vehicles supplied increasing as the price of such vehicles increases. Demand equals supply at the one and only point at which the Willingness To Pay of consumers is equal to the Willingness to Sell of dealers (the sellers). This is shown on Figure 1 as the intersection of the red demand curve and the purple supply curve. At this point, and only at this point, does the market clear with the marginal buyers and sellers having the same willingness to sell/pay. In this example, the market price is $28,000 with a volume sold of slightly more than 213,000 units.

21. In this illustration, the market price of the vehicle as represented is $28,000. What, then is the market price in the "but-for" world in which the "defeat device" is disclosed to the market? This market price is determined by demand and supply factors in the same way

as the market price of the vehicle as represented. For the sake of illustration, I draw a new demand curve that corresponds to a reduced WTP of consumers when defects are known. This curve is portrayed in Figure 1 by a green curve. The curve is shifted downward by $5,600[17] (20% of $28,000) to illustrate the Weir damages methodology. Demand curves only measure WTP and do not consider supply factors at all. In this illustration, the disclosure of defects results in a reduction in WTP of $5,600. This does NOT, contrary to Gaskin-Weir, mean that the market price declines by $5,600. The new market price is set by the intersection of the supply curve and the reduced "but-for" demand. The new price is only about $2,900 lower at $25,100. Anyone who uses reduction in WTP as a measure of damages will overestimate the reduction in market price. In this example, a reduction in WTP approach would yield damages of $5,600 per class member while the proper market price approach would yield damages of only $2,900 per class member (about half as large).[18]

22. It should be emphasized that in order to compute a market price, one must construct a true supply curve. Mr. Gaskin and Mr. Weir assert that to properly account for supply one only needs to consider the market price actually paid by class members.[19] This is clearly false. Merely noting market prices in the "actual" world of non-disclosure does not say anything about supply in the "but-for" world. To properly account for supply, we must have a supply curve and a market equilibrium, which means we must model

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[17] A downward shift in aggregate demand is caused by reductions in WTP on an individual consumer basis. This does not mean that each consumer has the same reduction in WTP but merely that the *average* reduction in WTP is $5,600.

[18] To be clear, I am not asserting that overpayment damages are actually owed here (or that the method described above would accurately measure overpayment damages).

[19] Weir Report, ¶ 34; Gaskin Report, ¶ 24.

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competition with other firms and consider costs of production.[20] Mr. Gaskin and Mr.

Weir do not do this, which renders their opinions unreliable.

5. The Gaskin-Weir Approach Cannot Measure Overpayment Damages

23. The Gaskin-Weir damages method does not and cannot reliably compute the difference

in market prices between the vehicles with and without full disclosure of the "defeat

device." The Gaskin-Weir method is simply a WTP calculation. I will explain why their

method is unreliable at this fundamental conceptual level.

Figure 2: Gaskin-Weir Methodology Illustrated
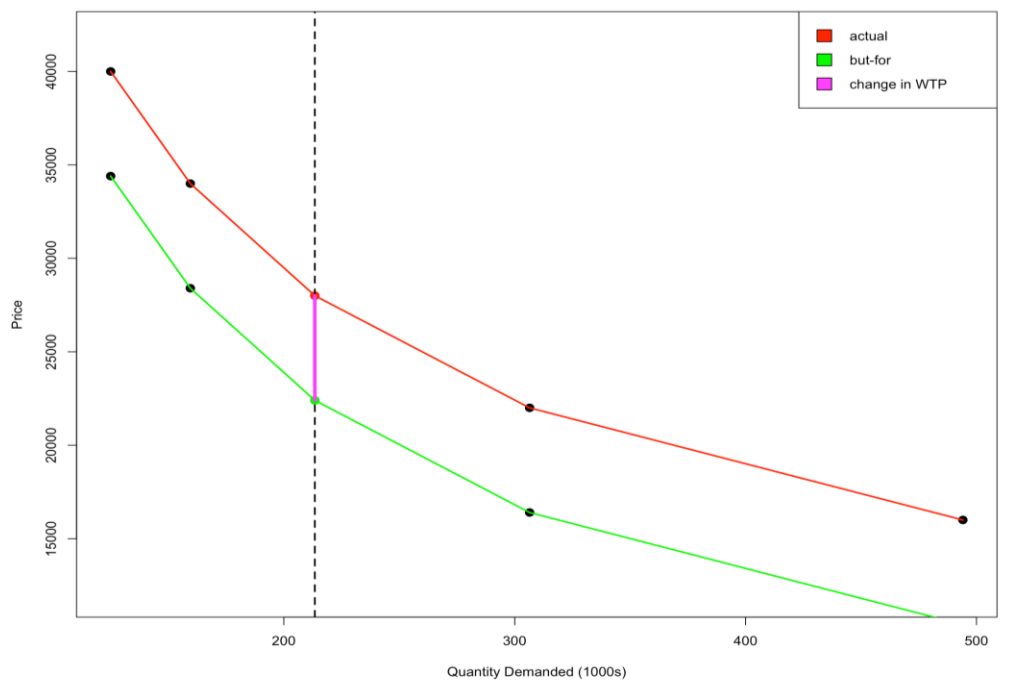
24. Figure 2 shows the same illustration of hypothetical demand for a vehicle with and without

disclosure of defects. The green Demand curve is the demand or WTP curve for a vehicle

in the actual world without disclosure of the "defeat device." I have recorded the actual

price paid by class members and the quantity sold ($28,000 and slightly more than 213,000)

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[20] "The supply curve shows the quantity of a good that producers are willing to sell at a given price . . .   The demand curve shows how much of a good consumers are willing to buy as the price per unit changes…. The two curves intersect at the equilibrium, or market-clearing, price and quantity." *See* Pindyck, R. S., and D. L. Rubenfeld (2013), *Microeconomics*, 8th ed., Upper Saddle River, NJ: Pearson Education Limited, pp. 22–25.

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units sold. Mr. Gaskin's entire survey process boils down to the computation of only one number – how much the demand curve will decline if alleged defects were more fully disclosed. As in Figure 1, the demand for this vehicle is purportedly reduced by $5,600 if the "defeat device" is disclosed.

25. Rather than also calculating the change in the number of cars supplied, Mr. Gaskin simply computes that amount by which price must fall in order to keep quantity sold constant. This is exactly the vertical difference in WTP between the red "actual" demand curve and the green "but-for" demand curve shown in Figure 2. This vertical distance is shown by a purple line. In this example, if we consider the world in which a full disclosure is made, demand will shift down from the red to the green curve. If we would like exactly the same number of consumers to be willing to buy the vehicle in this full-closure "but-for" world, we would simply reduce the price by $5,600. At this lowered price of $22,400 ($28,000 – $5,600), exactly the same number of consumers will be willing to buy the product. This is simply a definition of the reduction in WTP caused by the disclosure of defects. Thus, Mr. Gaskin is simply computing a reduction in WTP (change in WTP of $5,600) which is not a change or reduction in market price. This vertical difference between demand curves has nothing to do with supply considerations of any kind.

26. A proper calculation of economic damages requires a market price of the vehicle with full disclosure, which requires measuring the changes in both demand and supply. Mr. Gaskin does not compute market prices, nor does Mr. Weir. The only prices that they claim to consider in their damages calculation are the market prices of the vehicles actually paid by class members. But a reduction in WTP caused by full disclosure is not the same as calculating a new market price under full disclosure. This must be done by developing a

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supply curve that is based on costs of production, which would represent the seller's willingness to produce and sell those types of vehicles at that price.[21]

27. Mr. Gaskin claims that, since his conjoint purportedly uses the MSRP of actual vehicles to determine the range of prices in the conjoint, he has "considered" the supply side.[22] This is wrong as a matter of basic economics. Assuming that Mr. Gaskin actually uses MSRPs consistent with actual vehicles (which, as explained below, he does not), he simply constructs an estimate of a demand curve in the range of actual prices paid. This is not the same as constructing a supply curve.[23] Moreover, Mr. Gaskin fails to identify any way in which he has "considered" supply in the world of greater disclosure (for example, whether the manufacturer would be willing to pay the costs of production for the same number of vehicles if they can only sell them for the lower price). Only a rigorous calculation of market prices in the world of full disclosure can provide valid damages estimates for an overpayment analysis.

28. Mr. Weir does not remedy the failure of Mr. Gaskin's approach. The conjoint survey and subsequent computations by Mr. Gaskin provide the key component to Mr. Weir's damages calculations, namely the percentage reduction in market "value." The only other information used by Mr. Weir is the total number of class vehicles purchased by class members. However, what is missing is any supply side information on prices in the "but-for" world, which must be used to compute market prices.

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[21] As is made clear in Allenby et al. (2014), computing a market price involves both modeling market equilibrium as well as the costs of production, both figure in the determination of market price. Allenby et al. (2014) use the so-called Nash-Bertrand model of competition which is standard in an industry such as the automotive industry. *See* Allenby, G. M. et al. (2014), "Economic Valuation of Product Features," *Quantitative Marketing and Economics* 12, 4, 421–456, pp. 422, 424–425.

[22] Gaskin Report, ¶ 24.

[23] Even if the MSRPs used "reflect the actual market price that prevailed during the Class Period," Gaskin Report, ¶ 24, they do not purport to reflect the prices of the "but for" world. Similarly, his purported use of the "actual quantity of such vehicles sold during the Class Period", *id.*, does not necessarily reflect the quantity that would be produced in the "but-for" world.

29. Put another way, the Gaskin-Weir damages estimate depends only on conjoint survey data for computations of market price reductions required by an analysis of overpayment damages. This is unreliable to estimate market prices, as Allenby and Rossi state:

> "It should be emphasized that conjoint analysis can only estimate demand. Conjoint survey data, alone, cannot be used to compute market equilibrium outcomes such as market prices… Clearly, supply assumptions and cost information must be added to conjoint data in order to compute equilibrium quantities."[24]

This is further corroborated by Orme:

> "Conjoint simulators may be used to answer questions about new products and new product introductions…The market simulator focuses on the demand side of the marketing equation; but it is also important to pay attention to the supply side and take the costs of producing different products/services into consideration."[25]

30. In summary, neither Mr. Gaskin nor Mr. Weir can explain how their method can compute valid overpayment damages defined as the difference between the price paid by class members and the price that would have been paid with "full disclosure" of the "defeat device." Mr. Gaskin and Mr. Weir do not take into account competition and supply-side costs, which are the basis of any valid analysis of market prices. As such, Mr. Gaskin's and Mr. Weir's methodology is unreliable.

6. Mr. Weir's "offset" Alternative Damages Estimate

31. I have explained that Mr. Weir endorses the incorrect view that the fact that the Plaintiffs sold their vehicles prior to disclosure of the "defeat device" is not relevant to damages calculations ("It is therefore not economically required to deduct a portion of the damages

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[24] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 153.

[25] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, p. 96.

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if the Vehicles are subsequently resold."[26]). Despite this, Mr. Weir adds what he calls an "offset" damages calculation which he attributes to a directive by counsel – "Nonetheless, I have been asked by Counsel to demonstrate a method by which a measurement of such an 'offset' of damages, if legally required by the Court, would be calculated."[27] Mr. Weir's "offset" calculation is also unreliable, as I explain below.

32. Mr. Weir's "offset" approach does not accurately measure the alleged economic loss that could be suffered by Plaintiffs here. The "offset" calculation Mr. Weir proposes is simply to apply the Gaskin-derived percentage reduction in value to the resale price and that this quantity would be deemed as recovered damages by Plaintiffs. Thus, instead of the full 8.5 percent of original purchase price (which, as explained above, is an unreliable measure of damages at the time of purchase), Mr. Weir's "offset" damages reduce this amount by 8.5 percent of the resale price (see Table 3 of Weir report for examples[28]).[29]

33. Mr. Weir does not provide any economic justification of this "offset" calculation. He simply offers it without explanation. It appears that Mr. Weir may be endorsing a view that whatever premium can be ascribed to failure to disclose the "defeat device" depreciates over the life of the vehicle at the same rate as the rest of the vehicle. Thus, according to Mr. Weir, some, but not all, of the premium Plaintiffs were alleged to have paid is recovered at resale. Mr. Weir has not provided any evidence that whatever misrepresentation or omission made by the Defendants at the time of a purchase relating to the presence of the "defeat device" does not remain in the marketplace at the time of

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[26] Weir Report, ¶ 53.
[27] Weir Report, ¶ 54.
[28] Weir Report, ¶ 57.
[29] Mr. Weir does not apply his offset theory to lessees. However, even putting aside the unreliability of the number he uses, his method would be flawed because he does not account for the fact that a lessee's residual value would be higher and the monthly payments lower, and thus lessees would not have suffered any overpayment in the same manner as purchasers.

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resale and does not depreciate.   For example, the EPA emissions and mileage characteristics of cars do not necessarily depreciate over time, unlike moving physical parts of a car such as the engine and transmission, wear items like tires and brakes, and cosmetic items like paint and interior.

34. Mr. Weir has also compounded the errors he made in his original estimate, which incorrectly applied an 8.5 percent factor to the purchase price. I have explained why this calculation is incorrect and that Mr. Weir must estimate the price that would have prevailed in the market at the point of purchase by the Plaintiffs if the "defeat device" was disclosed. Neither Mr. Weir nor Mr. Gaskin can provide any information regarding this "but-for" market price, as Mr. Gaskin's conjoint survey cannot be used to compute market prices. To be consistent under Mr. Weir's "offset" approach, one would have to calculate not only the market price in the "but-for" world at the point of purchase but also at the point of Plaintiffs' resale of their vehicles.[30] Mr. Weir has not done this, nor is it possible for him to do this, based only on the Gaskin survey results. His offset method thus suffers from the same issues at both the point of purchase and the point of resale.

35. Moreover, I note that Mr. Gaskin explicitly says that his survey cannot be used to undertake valuations for used vehicles, as required for the Weir offset analysis (see footnote 32, p. 19 of the Gaskin report). Mr. Weir's proposed "offset" methodology is thus unreliable by Mr. Gaskin's own terms.

7. "Market Simulator"

7.1 Conjoint Surveys and "Market Simulators" Explained

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[30] Again, for lessees, this would be incorporated into the estimated residual ("resale") value at the time the lease was initially calculated. No effort has been made by either Mr. Gaskin or Mr. Weir to calculate how the estimated residual value would have changed in a "but-for" world.

36. I have explained that no computations of any kind which rely solely on a demand estimates from a conjoint survey can be used to compute the market price in the "but-for" world of "full" disclosure. I will now discuss in more detail the problems with the so-called "market simulators" Mr. Gaskin uses to compute his "reduction-in-value" percentage, which is the sole basis for Mr. Weir's damage calculation.

37. Before beginning this discussion, I will briefly explain how a conjoint survey works and what conjoint practitioners term "market simulators." The best way to view a conjoint survey is an attempt, with survey methods, to approximate the purchase decisions of actual consumers. In a proper survey, respondents are screened to include only those consumers who are in the market for the products that are the subject of the conjoint survey. In the conjoint survey, several hypothetical products are presented to the survey respondent in what is called a "choice task." The respondent is asked to pick one of the alternatives presented for purchase. In most conjoint surveys, an "outside" or "none of the above" alternative is also available. This choice task is repeated with different sets of hypothetical products for ten or more repetitions, each with different products. Each hypothetical product is represented to the respondents in the form of a set of product features (called "attributes"), and each feature is specified as a given level. For example, Mr. Gaskin represents vehicles by a combination of eight attributes – manufacturer, option package, braking performance, navigation systems, seating, "engine type" (with and without "defeat device"), seal cap performance, and price.[31] For most of these features, the levels used in the conjoint are simply the absence or presence of the feature or defect. However, here there are five levels of price from $16,000 to $40,000.[32] In an on-line conjoint survey, the

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[31] Gaskin Report, pp. 18–26.
[32] Gaskin Report, p. 26.

choice tasks are presented as a sequence of choice screens. Each screen is a table with rows that correspond to features and with columns that correspond to different hypothetical products.[33]

38. The choice data is then collected from hundreds of respondents and then analyzed with conjoint software. While the statistical analysis is complicated, the results are a set of weights (called "partworths") for each of the respondents. These weights embody the tradeoffs that the respondents make between attributes. A respondent who is very price sensitive would have a very large weight associated with price. For each respondent, the weights for each attribute correspond to the relative importance of attributes to that respondent.

39. Conjoint analysis does not end with the production of partworths for each respondent. In order to translate the analysis into something more useful for the sponsor of a conjoint, the partworths are used to simulate or forecast demand for a set of competing products. These demand forecasts are typically in the form of predicted market shares. For example, a manufacturer might be interested in what would happen if adaptive cruise control was added to a popular model. The conjoint survey (if it included the adaptive cruise control attribute) would be used to see if the addition of this feature to an existing make and model and trim would result in appreciably increased sales or market share in competition with other major makes and models, which the manufacturer could use (in conjunction with its own production costs) to decide whether to add that feature to its vehicle. This is how "market simulators" came to be popular applications of conjoint analysis. Mr. Gaskin does not use "market simulators" for their intended purpose, as I will explain below.

7.2 Mr. Gaskin's Errors in Use of a "Market Simulator"

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[33] *See*, for example, Gaskin Report, p. 6.

40. In this section, I will describe further errors made by Mr. Gaskin in misusing and mis-characterizing what conjoint practitioners refer to as "market simulations." Before going into details of these errors, it is important to remember that "market simulations" are a misnomer:

> "Conjoint practitioners have chosen the unfortunate term 'market simulation' to describe demand predictions based on conjoint analyses. These practices are not simulations of any market outcome…"[34]

Conjoint can, at best, only compute estimates of consumer demand.[35] One way of seeing this is that only consumers are surveyed. If it was desired to construct a supply curve *using survey methods*, then one would need to survey dealers and manufacturers, at the very least. Since Mr. Gaskin only surveys consumers, his conjoint, however carefully done—and it is not carefully or reliably done—cannot measure supply and therefore cannot be used to compute market prices.

41. Mr. Gaskin uses the "market simulator" capability of Sawtooth software to compute his purported "reduction in market value."[36] In this section, I will illustrate further errors made by Mr. Gaskin in the use of the "market" simulation even for the purpose of demand forecasts alone, which make Mr. Gaskin's analysis unreliable. I will show mathematically that Mr. Gaskin, at best, can only compute the change in consumer Willingness To Pay with his "market simulator."

42. In chapter 10 of *Getting Started with Conjoint Analysis* (cited by Mr. Gaskin), Brian Orme (president of Sawtooth Software) explains the purpose of "market simulations" and also

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[34] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 153.

[35] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 153.

[36] Gaskin Report, ¶ 59.

describes some common mistakes used in their application. The idea of a market simulator is simple. One creates a hypothetical market that contains a set of products designed to represent the principal products in the market place. Products are specified by brand and a bundle of other attributes including prices. That is, in order to execute a "market simulation" one must first determine the major competing products and set hypothetical prices for these products. For example, a new product feature might be available and the "market" simulator would be used to forecast enhanced demand for a firm's product(s) with this added feature. Clearly, this is simply a demand forecast without any supply considerations. That is, prices are fixed and are inputs to this procedure. There is no determination of market price.

43. Mr. Gaskin does not use market simulations for demand forecasting as they were invented for. Instead, Mr. Gaskin uses these "market simulators" to compute a WTP for a change in product feature. In Appendix D, I show mathematically that Mr. Gaskin's measure based on a market simulator is simply a standard WTP measure. This is a misuse of the "market simulator." These simulators are designed to make demand forecasts with some view as to the extent of competition and conditional on prices. It is clear that Orme views market simulators as pure demand forecasts. [37] This method thus does not determine market prices at all.

44. The usefulness of a demand forecast depends critically on whether all major competitors are included in the analysis. In Mr. Gaskin's conjoint, only two brands (VW and Audi) are used without considering any of the many other key brands. For example, other brands compete with VW and Audi vehicles, such as Honda, Toyota, and BMW. Mr. Gaskin

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[37] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, Section 10.5.

goes to even greater extremes by constructing a "market simulator" that depends on only two VW products (a product with the "defeat device" and one without).[38] This is not even a realistic simulator of the VW/Audi sub-segment of diesel cars.

45. Notably, Mr. Weir agrees that the automotive industry is a "mature" industry that is "highly competitive."[39] Mr. Weir goes on to say that there are many competitors for VW/Audi and quotes statements manufacturers to that effect.[40] Mr. Weir's statements to this effect appear to criticize Mr. Gaskin for his failure to include any VW/Audi competitors in his market simulation.

46. The problem of using unrealistic sets of products to characterize a market has long been known by conjoint practitioners. In fact, Orme uses a "Gilligan's Island" example of the danger of not including all major competitive products in a demand simulator.[41] In this example, Orme considers the wealthy Howells and their demand for transportation off of Gilligan's Island. The Howells have a high WTP to leave the island and would certainly buy even expensive transportation off the island. However, if there was a cheap ferry established, they wouldn't buy the expensive alternatives anymore. Thus, in order to simulate demand in a realistic setting, one needs to carefully specify the set of competing products in order to properly account for competitive effects.

Allenby and Rossi (2014) conclude:

"Most practitioners of conjoint are aware that, for realistic market simulations, the major competing products must be used. This means that the product attributes in the study should include not only functional attributes … but also the major brands."[42]

Orme also finds that:

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[38] Gaskin Report, ¶ 59.

[39] Weir Report, ¶¶ 39–45.

[40] Weir Report, ¶¶ 41–42.

[41] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, pp. 90–91.

[42] Allenby, G. M. et al. (2014), "Economic Valuation of Product Features," *Quantitative Marketing and Economics* 12, 4, 421–456 at 433.

> "If a firm wants to assess the incremental demand resulting from offering specific features for its product … it should be estimated within a realistic competitive context. […] [T]he success of the simulation approach hinges on a number of assumptions, including … the relevant competitive offerings are reflected in the simulation model."[43]

47. In short, Mr. Gaskin's "market simulation" is not even a valid demand forecast as the developers of the software he uses intend, lacking even the presence of competing products.   Instead, Mr. Gaskin uses his incorrectly designed "market simulator" to compute the price reduction required to bring the demand for a hypothetical vehicle with disclosure of the "defeat device" to that of the demand for the product without disclosure. This is the definition of change in WTP for the product.[44] Mr. Gaskin is not simulating a market price of any kind, much less the market price in the "but-for" hypothetical world where the "defeat device" is disclosed.

48. Mr. Gaskin repeatedly refers to his "market simulation" calculations as estimates of change in market value. As I have explained, they are not. In fact, Orme, whom Mr. Gaskin cites repeatedly as an authority on conjoint, agrees with me:

> "Finally, one can use conjoint simulations to find WTP. To do this, we simulate a set of competing products A and B. Product A possesses the feature and has the current price. Product B lacks the feature and we set its price so that A and B each have 50% share. **The difference in price that equalizes the shares is an estimate of WTP**."[45]

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[43] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC*,* pp. 91–92.

[44] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 162.

[45] Orme, B. K., and K. Chrzan (2017), *Becoming an Expert in Conjoint Analysis: Choice Modeling for Pros*, Orem, Utah: Sawtooth Software, Inc., p. 194 (emphasis added).   Notably, Mr. Gaskin also claims that this is a correct description of his methodology. *See* Gaskin Report, footnote 39, p. 29.

In Mr. Gaskin's case, "product A" is the vehicle that meets emission standards and "product B" is the vehicle with the "defeat device" that does not. This is precisely what Mr. Gaskin has done to compute his 8.5 percent reduction in WTP.

7.3 Mr. Gaskin's WTP Calculations Are Unreliable

49. I have explained that Mr. Gaskin's calculations are not a change in market value or price, but merely a WTP calculation and therefore are irrelevant to and unreliable for damage assessment. However, Mr. Gaskin has not produced a credible estimate of even an alleged reduction in WTP associated with the "defeat device." Mr. Gaskin masks fundamental flaws in his approach when he states in his report that his estimate of change in WTP is 8.5 percent. In fact, (see Gaskin report, Exhibit K-2 and supporting materials[46]) Mr. Gaskin produces eight different WTP percentage reductions. He does not report these calculations in the main body of his report and, even in the appendix, Mr. Gaskin does not convert his numbers into percentages. This makes it difficult for a casual reader to appreciate how unreliable his calculations are.

50. To implement his WTP calculations, Mr. Gaskin must "simulate" market shares for two products – one vehicle that meets EPA standards and one that does not (the one with the "defeat device").[47] He must pick a base price for his calculation. His conjoint survey uses an unrealistic range of five prices - $16,000, $20,000, $28,000, $34,000 and $40,000. He has two methods to compute WTP. He could set the price for the vehicle that meets EPA standards and then adjust the price of the other, non-complaint vehicle downward so that the sales of each vehicle are the same. The difference in these prices, expressed as a percentage, would be an estimate of the reduction in WTP. The other way to implement

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[46] "Exhibit N_Conjoint Data Listing.xlsx," "nvvw.ssi" from Gaskin productions.
[47] Gaskin Report, ¶ 59.

such a calculation is to fix the price of the vehicle that does not meet EPA standards and adjust the price of the conforming vehicle upward until sales are equal. Thus, there are a total of eight possible reductions in WTP computations depending on which of the five base prices are used and whether we raise the price of the vehicle that meets EPA emissions standards or lower the price of the vehicle that does not.[48] If Mr. Gaskin's method and data were at all reliable, these eight calculations would agree closely. They do not.

51. Table 1 below shows all eight calculations of WTP expressed as a percentage.

Table 1: Mr. Gaskin's WTP calculations as a percentage

Base price	$22,000	$28,000	$34,000	$40,000		$16,000	$22,000	$28,000	$34,000
	Lowering the price of the less preferred vehicle					Raising the price of the more preferred vehicle			
Percentage change in WTP for "Diesel engine that meets NOx emission standards during both testing and driving" vs. "Diesel engine that only meets NOx emission standards during testing"	At least 27.3% [49]	26.3%	13.7%	8.5%		60.5%	29.4%	16.6%	10.1%
Source: Gaskin Report, Exhibit K-2; Gaskin production ("Exhibit N_Conjoint Data Listing.xlsx", "nvvw.ssi")									
Note: See "Workpaper 1 - Exhibit K Percentages.xlsx" for details.									

The estimates in the table range widely from 8.5 percent to more than 60 percent. Mr. Gaskin argues that he is being "conservative" in selecting the lowest percentage. But that is not an economically sound assumption; nor is it justified as a matter of economic theory.

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[48] Note: we cannot lower price below $16,000 or raise price above $40,000 so that there are eight, not ten possibilities.

[49] Lowering the price to $16,000 (a reduction of 27.4%) is not sufficient to equalize sales of the two vehicles, and the price cannot be lowered beyond $16,000. Thus, a reduction of *at least* 27.3% is required to equalize the sales.

Rather, Mr. Gaskin's own calculations demonstrate extreme sensitivity to choice of base price and, therefore, demonstrate that his methodology is not reliable.

52. To further demonstrate the unreliability of Mr. Gaskin's method, I also apply Mr. Gaskin's change in WTP method to the other features or attributes in his survey. I consider four other features:

1. Gasoline vs Diesel Engine Type

2. Leather vs. Cloth Seating

3. Presence of a Navigation System

4. VW vs. Audi brand

I computed a percentage change in WTP using the identical Gaskin methodology, which under Mr. Gaskin's proposed method would purportedly show the premium consumers would be willing to pay for that feature (or would value the vehicle less if it did not have that feature), holding all other features the same. These calculations are shown in Table 2 below. The unreliability of Mr. Gaskin's methodology is immediately apparent from the results. For each feature, the percentages vary widely, more than tripling from low to high in each instance, and show improbable results. For example, Table 2 shows that a "full suite" of navigation services has a WTP of between $3,678 and $9,770. The $9,770 number applies to a vehicle in the conjoint that has a price of only $16,000. That is an irrational result that sheds doubt on the reliability of Mr. Gaskin's conjoint analysis, as it is hard to believe that any consumer would value navigation services at more than half of the vehicle price. In the real world, by contrast, consumers would only be charged $2,000 to add a navigation system to a 2011 Audi A3 TDI with a base MSRP of $30,250, or $1,200 to add a navigation system to a 2011 VW Jetta TDI with a base MSRP of $22,995.[50] The

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[50] *See* VW-Pre-NOV-00000005–59 at 07; VW-Pre-NOV-000000060–79 at 65.

estimate of consumers' WTP for a navigation system derived using Mr. Gaskin's methodology is much larger than observed real-world pricing behavior, confirming the unreliability of his methodology.

Table 2: WTP for Vehicle Features [1]

Base price	$22,000	$28,000	$34,000	$40,000		$16,000	$22,000	$28,000	$34,000
	Lowering the price of the less preferred vehicle					Raising the price of the more preferred vehicle			
Percentage change in WTP for Gasoline vs. Diesel engines that meet emissions during testing and driving [2]	>27.3% (>$6,000)	21.4% ($5,982)	12.9% ($4,396)	8.0% ($3,199)		56.0% ($8,964)	27.2% ($5,981)	15.8% ($4,412)	9.4% ($3,204)
Percentage change in WTP for Volkswagen brand vs. Audi brand [3]	14.2% ($3,129)	5.2% ($1,465)	3.2% ($1,087)	2.0% ($819)		19.9% ($3,188)	6.6% ($1,453)	3.9% ($1,091)	2.4% ($810)
Percentage change in WTP for Leather Seats vs. Cloth Seats [4]	>27.3% (>$6,000)	26.4% ($7,400)	14.1% ($4,796)	9.0% ($3,613)		61.2% ($9,785)	29.6% ($6,509)	17.1% ($4,793)	10.6% ($3,595)
Percentage change in WTP for "Full Suite of Services" Navigation System vs. No Navigation System [5]	>27.3% (>$6,000)	26.6% ($7,448)	14.3% ($4,871)	9.2% ($3,678)		61.1% ($9,770)	29.5% ($6,495)	17.4% ($4,883)	10.8% ($3,680)

Source: Gaskin production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx", "nvvw.ssi")

[1] See "Workpaper 2 – WTP for Vehicle Features.xlsx" for details.

[2] Attribute values for simulation – Manufacturer: Volkswagen, Options Package: Mid-Level, Seating: Leatherette, Navigation System: Mid-Level, Seal Cap Performance: Reliable, Braking Performance: Reliable.

[3] Attribute values for simulation – Engine: Diesel engine that meets emissions during testing and driving, Options Package: Mid-Level, Seating: Leatherette, Navigation System: Mid-Level, Seal Cap Performance: Reliable, Braking Performance: Reliable.

[4] Attribute values for simulation – Engine: Diesel engine that meets emissions during testing and driving, Manufacturer: Volkswagen, Options Package: Mid-Level, Navigation System: Mid-Level, Seal Cap Performance: Reliable, Braking Performance: Reliable.

[5] Attribute values for simulation – Engine: Diesel engine that meets emissions during testing and driving, Manufacturer: Volkswagen, Options Package: Mid-Level, Seating: Leatherette, Seal Cap Performance: Reliable, Braking Performance: Reliable.

53. As another example of the unreliability of Mr. Gaskin's survey results, they show that the VW brand has a premium over the Audi brand of between $810 and $3,188, which is

contrary to Audi's real-world market position as a maker of luxury vehicles that VW does not have. For instance, the 2011 Audi A3 TDI with four doors and an automatic transmission had a base MSRP of $30,250, as opposed to a comparable 2011 VW Golf TDI with an MSRP of $24,985.[51] Mr. Gaskin's methodology purports to identify consumer WTP that is, again, contrary to market reality.

54. Mr. Gaskin's results are also contrary to market reality with respect to customer engine preferences at issue in this case. Mr. Gaskin's methodology shows that "engine type" of "gasoline" was valued higher than diesel engines by survey respondents, by a minimum of $3,199. This directly contradicts the fact that many of the Plaintiffs paid a premium for their TDI diesel engines over a comparable gasoline-driven model. This preference for gasoline engines suggests that the sample is not representative of the named Plaintiffs or the proposed class, or of the real world, where TDIs were priced higher than gasoline vehicles. For example, a 2011 Audi A3 with a 2.0L TDI engine had an MSRP of $30,250 while a comparably equipped vehicle with a 2.0L gasoline engine had an MSRP of $28,750.[52] I show below in Section 8.6 that Mr. Gaskin erred in allowing owners of gasoline-powered vehicles to be included in his sample.

8. Conjoint Survey Design

8.1 Brands and Important Features

55. Mr. Gaskin did not do any primary consumer research as is customary prior to designing a conjoint survey. Instead Mr. Gaskin relied exclusively on his review of websites and

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[51] *See* VW-Pre-NOV-00000005–59 at 07; VW-Pre-NOV-000000060–79 at 61. The 2011 Audi A3 was "based on the same platform as the Volkswagen Golf." *See* "Buyers Guide: 2011 Audi A3," Motortrend, https://www.motortrend.com/cars/audi/a3/2011/, accessed on March 11, 2020.

[52] VW-Pre-NOV-00000005–59 at 07. Similarly, a two-door 2011 VW Golf with a 2.5L gasoline engine and automatic transmission had an MSRP of $19,095, as opposed to a comparable 2011 VW Golf with a TDI engine, which had an MSRP of $24,325. *See* VW-Pre-NOV-00000060–79 at 61.

marketing brochures and manuals. [53]   These documents do not provide sufficient information regarding how consumers view the choice between models of Audi and Volkswagen vehicles and other competitors' vehicles in the market.

56. It is vital that a conjoint design include major product features and that these features are described in a way that is intelligible to consumers. As Orme points out,

> "Defining proper attributes and levels is arguably the most fundamental and critical aspect of designing a good conjoint study."[54]

> and

> "Attribute descriptions should be concise statements with concrete meaning."[55]

Allenby and Rossi make this explicit:

> "This means that … we must include many of the other important features in the product."[56]

> and

> "It is important to undertake research prior to the conjoint survey design to determine the major and most important features of the product."[57]

57. Understanding the important features and how consumers understand these features is why careful conjoint practitioners conduct preliminary qualitative research often via focus groups.[58] Mr. Gaskin's approach bypasses this stage of design and creates a conjoint

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[53] Gaskin Report, ¶ 28.
[54] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, p. 53.
[55] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, p. 54.
[56] Allenby, G. M. et al. (2014), "Valuation of Patented Product Features," *Journal of Law and Economics* 57, 3, 629–663 at 642.
[57] Allenby, G. M. et al. (2014), "Valuation of Patented Product Features," *Journal of Law and Economics* 57, 3, 629–663 at 642. *See* also Rao, V. R. (2014), *Applied Conjoint Analysis*, Berlin/Heidelberg, Germany: Springer, p. 43: "[S]election of attributes and levels is a very crucial step in the design of conjoint studies. … The scientific aspects arise from an understanding of the consumer's choice process, more specifically salient attributes involved in the choice of an alternative by a majority of target consumers."
[58] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 166.

questionnaire without doing any primary research. It is thus not surprising that his survey

only considers two brands and omits many important attributes for vehicle purchase

contrary to accepted methodologies. For example, he fails to provide many attributes that

consumers consider important such as mileage, acceleration, and trunk capacity. Certainly,

Mr. Gaskin has not shown that he has included major important features.

58. Mr. Gaskin claims to have chosen "distractor" vehicle features by examining the NHTSA

web site regarding vehicle defects.[59] In addition to the "emissions" attribute, Mr. Gaskin

also includes "seal cap" and "braking performance" attributes.[60] Information about these

product defects is provided to all conjoint respondents along with extensive explanation

of the meaning of these attributes. For example, the "seal cap" attribute includes a "level"

in which a defect in the fuel cap seal would cause a fire hazard.[61] Conjoint was designed

to be used only for those product features provided at the point of sale to consumers. Mr.

Gaskin is silent on how consumers would be informed of any of the three features that

represent some sort of product defect (three out six other product features – not including

price). No consumer goes into a car dealership or visits an on-line car buying site and is

informed that a vehicle has a product defect that causes a fire hazard.[62]

59. Conjoint surveys are only valid approximations to actual purchase environments to the

extent that the survey mirrors reality.[63] Mr. Gaskin does not explain what circumstances

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[59] Gaskin Report, ¶ 29.

[60] Gaskin Report, ¶ 29.

[61] Gaskin Report, p. 24.

[62] Mr. Gaskin nowhere clarifies that the change in emissions is *not* an imminent safety hazard, which may be implied by the presence of multiple other safety hazards as options.

[63] "The menus of products and their descriptions are designed to realistically mimic a market experience where a consumer can choose among various competing products… The goal of a conjoint study designed for prediction should be to anticipate and mimic the training that real markets provide. …" *See* Ben-Akiva, M., B. McFadden, and K. Train (2019), "Foundations of Stated Preference Elicitation: Consumer Behavior and Choice Based Conjoint Analysis," *Foundations and Trends in Econometrics* 10, no. 1–2, 1–144, pp. 11, 26. "The profiles presented [in conjoint analysis] should be believable (and should resemble existing products as much as possible)." *See* Rao, V. R. (2014), *Applied Conjoint Analysis*, Berlin/Heidelberg, Germany: Springer, p. 45.

would lead to consumers being informed at the point of purchase regarding many different vehicle defects. This renders his survey unreliable and unable to approximate actual purchase behavior.

8.2 Survey Biases

60. It is important to design any survey so as to avoid biases.[64] Mr. Gaskin claims that his survey is designed to test and value the extent to which respondents put value on the adherence of a diesel engine to EPA emission standards during "normal driving." [65] However, his survey tests a compounding of both the failure to meet emission standards and also (for example) the risk that the manufacturer may "eventually offer a free update that reduces the level of NOx emissions during normal driving, but the update may somewhat degrade the fuel economy and performance of the vehicle."[66] This additional aspect of the feature means that Mr. Gaskin is not addressing the pure or partial effect of emission non-compliance but also a possible and unspecified reduction in performance. Since any rational consumer will value improved fuel economy (and most will value higher performance) all else being equal, this compounding in the survey design biases the responses toward a great reduction in value than a survey that is designed to isolate the effects of emissions compliance alone. This biases any result of the Gaskin survey in favor of higher damages for the Plaintiffs.[67]

8.3 Implausible and Extreme Combinations of Price and Model

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[64] Diamond, S. H. (2011), "Reference Guide on Survey Research," in *Reference Manual on Scientific Evidence*, 3rd ed., Washington, DC: The National Academies Press, 359–423, Section IV.A.

[65] Gaskin Report, ¶ 16.

[66] Gaskin Report, p. 19.

[67] The potential (possible) reduction in fuel economy is not the only risk Mr. Gaskin fails to exclude from his survey. For example, in the real world, the vehicles remained legal to drive and sell despite the violation of emissions standards; without explaining this fact, the survey may be biased towards a greater reduction in value.

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61. Mr. Gaskin uses a range of five prices between \$16,000 and \$40,000 in his conjoint design.[68] As is obvious from Figure 1 of Mr. Gaskin's report,[69] respondents are exposed to highly implausible and non-existent combinations of prices and vehicle models. Across all 2019 and 2020 new Audis for sale at the time the survey was administered, the lowest starting MSRP is \$33,300 (2019 and 2020 Audi A3) – hence, there is no 2019 or 2020 Audi with MSRP lower than that price.[70] Yet, Mr. Gaskin exposes respondents to absurd combinations such as a "mid-level model" Audi priced at \$16,000. Similarly, across all 2019 and 2020 new VWs for sale, the lowest starting MSRP is \$18,745 (2019 Jetta),[71] above Mr. Gaskin's lowest price level of \$16,000.[72]

62. Mr. Gaskin's conjoint survey included many choice tasks with Audis and VWs priced below the minimum MSRPs observed in the market. In the conjoint survey, there were 785 choice tasks with Audis priced at \$16,000, 778 choice tasks with Audis with a price of \$22,000, and 790 choice tasks with Audis with a price of \$28,000.[73] There were also 774 choice tasks with VWs with a price of \$16,000.[74] In total, such profiles appeared in 85.1%

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[68] Gaskin Report, p. 26.

[69] Gaskin Report, Figure 1, p. 6.

[70] *See* "Audi Cars: Sedans - SUVs - Coupes - Convertibles," Audi, https://www.audiusa.com/models#, accessed on March 13, 2020; "Audi Cars: Sedans - SUVs - Coupes – Convertibles," Audi [archived July 27, 2019], https://web.archive.org/web/20190727204126/https://www.audiusa.com/models, accessed on March 13, 2020.

[71] *See* "VW Model Lineup – Cars and SUVs Volkswagen," Volkswagen, https://www.vw.com/models/, accessed on March 13, 2020; VW Model Lineup – Cars and SUVs Volkswagen," Volkswagen [archived July 29, 2019], https://web.archive.org/web/20190729215700/https://www.vw.com/models/, accessed on March 13, 2020.

[72] "The profiles presented [in conjoint analysis] should be believable (and should resemble existing products as much as possible)." *See* Rao, V. R. (2014), *Applied Conjoint Analysis*, Berlin/Heidelberg, Germany: Springer, p. 45; "Of general concern is the question about the realism of the task required from interviewees….. If … the hypothetical objects differ dramatically from the actual objects (products) available, the task will be more demanding and the judgments may not be as representative of what an individual would actually do in a marketplace setting." *See* Cattin, P. and D. R. Wittink (1982), "Commercial Use of Conjoint Analysis: A Survey," *Journal of Marketing* 46, 3, 44–53, p. 51.

[73] Gaskin production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx," "nvvw.ssi"). *See* "Workpaper 3 – Implausible Options.R" for calculations.

[74] Gaskin production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx," "nvvw.ssi"). *See* "Workpaper 3 – Implausible Options.R" for calculations.

of actual choice tasks presented in the conjoint survey.[75] At least one such instance was

encountered during the conjoint survey by every one of the 221 final respondents.[76]

63. These implausible combinations of price and model undermine the credibility of the

survey responses. Respondents are exposed to extremes that they would never encounter

in the market place. This has very serious detrimental effects on the validity of a conjoint

design. Mr. Gaskin instructed his respondents to "assume that the vehicle does not vary

on any other feature other than the features shown" below. Respondents see an Audi

priced at $16,000—well below what Audis sell for in the real world—and may infer that

this is a used vehicle or a defective vehicle. Similarly, respondents were also shown VW

vehicles priced at $40,000. Here they may incorrectly infer these vehicles are heaped with

luxury options. The effect of unrealistic and extreme hypothetical products in the conjoint

is also to reduce price sensitivity since respondents do not believe that the only difference

between conjoint choice alternatives is the stated attributes. It is well known that lowering

price sensitivity will bias any WTP calculation upward.[77]

64. Not only does the improper use of prices in the conjoint design render the conjoint results

unreliable and biased, it also calls into question the arguments made by Mr. Weir that Mr.

Gaskin used "supply side considerations" in his analysis. Mr. Weir asserts that Mr.

Gaskin's survey "includes market-based price points." [78] In fact, Mr. Gaskin's

combinations of price and make are not "market-based" at all in that they are completely

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[75] Gaskin production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx," "nvvw.ssi"). *See* "Workpaper 3 – Implausible Options.R" for calculations.

[76] Gaskin production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx," "nvvw.ssi"). *See* "Workpaper 3 – Implausible Options.R" for calculations.

[77] "If respondents spend survey dollars too liberally, this will make their utility for price too small and it will exaggerate their apparent willingness to pay for product features." Orme, B. K., and K. Chrzan (2017), *Becoming an Expert in Conjoint Analysis: Choice Modeling for Pros*, Orem, Utah: Sawtooth Software, Inc., p. 195.

[78] Weir Report, ¶ 24.

at variance with actual market pricing. This makes Mr. Gaskin's and Mr. Weir's opinions and analyses unreliable and contrary to accepted methodologies.

8.4 Product Aggregation

65. The validity of conjoint survey data is dependent critically on how closely the conjoint choice exercise approximates the actual purchase decisions of consumers.[79] No one sets out to purchase a generic "mid-level" model described by only a handful of features, no one of which is demonstrably important to any consumer. Consumers choose between specific makes and models of cars. In order for Mr. Gaskin's survey to reliably approximate reality, the survey must specify the specific make and model of VW and Audi vehicles in the same way as many of the car buying websites (such as Kelley Blue Book or Edmunds) display information. It is not possible to inquire about a generic vehicle and no consumer will ever have had this experience. This is why car manufacturers, who use conjoint to measure demand for new product features, often employ explicit prototypes of a specific model of car.

66. It is not necessary that every specific product be used in a conjoint but, rather, it is important the products used in the choice tasks are exemplars of important product features, makes and models.[80] Mr. Gaskin's conjoint design falls far short of this standard and is contrary to accepted conjoint methodologies.

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[79] "The menus of products and their descriptions are designed to realistically mimic a market experience, where a consumer can choose among various competing products… The goal of a conjoint study designed for prediction should be to anticipate and mimic the training that real markets provide. …" *See* Ben-Akiva, M., B. McFadden, and K. Train (2019), "Foundations of Stated Preference Elicitation: Consumer Behavior and Choice Based Conjoint Analysis," *Foundations and Trends in Econometrics* 10, no. 1–2, 1–144, pp. 11, 26. "The profiles presented [in conjoint analysis] should be believable (and should resemble existing products as much as possible)." *See* Rao, V. R. (2014), *Applied Conjoint Analysis*, Berlin/Heidelberg, Germany: Springer, p. 45.
[80] "It is important to undertake research prior to the conjoint survey design to determine the major and most important features of the product." Allenby, G. M. et al. (2014), "Valuation of Patented Product Features," *Journal of Law and Economics* 57, 3, 629–663, p. 642. *See* also Rao, V. R. (2014), *Applied Conjoint Analysis*, Berlin/Heidelberg, Germany: Springer, p. 43: "[S]election of attributes and levels is a very crucial step in the design of conjoint studies. … The scientific aspects arise from an understanding of the consumer's choice

8.5 Demand Effects

67. Mr. Gaskin did not ask his final survey respondents whether they were aware of litigation regarding emissions for diesel-powered vehicles as would be standard in litigation surveys. However, in his pre-testing, he did ask respondents "do you have a belief about who might be the sponsor of this study?", to which 8 out of 10 pretest respondents thought that the survey sponsors were VW and/or Audi.[81] This raises the very real possibility of what survey experts call "demand effects," namely attempts by the respondents to infer the purpose of the survey and to bias their responses toward the end of what they think the sponsors of the survey want to see.[82]

8.6 Errors in Sample Screening

68. This litigation only concerns certain models of diesel-powered vehicles and does not concern any vehicle powered by a gasoline engine. Mr. Gaskin did not screen to only owners of at-issue diesel-powered VW and Audi cars, but included *all* owners of VW and Audi cars of the at-issue models and model years in his survey. Table 3 shows that the majority of U.S. VW and Audi sales for at-issue models and model-years are of gasoline-powered cars.[83]

Table 3: Diesel and Gasoline Shares of Select Audi and Volkswagen Vehicles [1]

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process, more specifically salient attributes involved in the choice of an alternative by a majority of target consumers."

[81] Gaskin Report, Exhibit G, pp. G-1, G-3, G-5, G-7, G-9, G-11, G-13, G-15.

[82] Demand effects (also known as demand artifacts) "include all aspects of the experiment which cause the subject to perceive, interpret, and act upon what he believes is expected or desired of him by the experimenter. … The effects of demand artifacts pose important threats to both internal and external validity." *See* Sawyer, A. G. (1975), "Demand Artifacts in Laboratory Experiments in Consumer Research," *Journal of Consumer Research* 1, 4, 20–30 at 20. *See* also Shimp, T. A., E. M. Hyatt, and D. J. Snyder (1991), "A Critical Appraisal of Demand Artifacts in Consumer Research," *Journal of Consumer Research* 18, 3, 273–283.

[83] *See* "Workpaper 4 - Diesel and Gasoline Shares.xlsx" for details.

Make	Model	As a % of Total New Registrations[2]	
		Diesel	Gasoline
Volkswagen	Jetta[3]	31.3%	67.8%
Volkswagen	Passat[4]	30.5%	69.5%
Volkswagen	Beetle[5]	8.9%	91.1%
Volkswagen	Golf[6]	44.1%	52.9%
Audi	A3[7]	20.1%	79.9%

Source: IHS Data from Stockton Production ("IHS Markit New Summary Registration Data File, 2009 - 2010 (11_2012 Update).xlsx", "IHS Markit New Summary Registration Data File, 2011 - 2012 (2_2016 Update).xlsx", "IHS Markit New Summary Registration Data File, 2013 - 2015 (12_2018 Update).xlsx.")

Note:

[1] New registrations for make and model include all at-issue model years included in Gaskin conjoint sample.

[2] Total includes categories of "Electric" and "Gas + Electric." As a result, Diesel and Gasoline percentages may not add up to 100%.

[3] At-issue model years included are 2009–2015.

[4] At-issue model years included are 2012–2015.

[5] At-issue model years included are 2012–2015.

[6] At-issue model years included are 2010–2015.

[7] At-issue model years included are 2010–2015. Gasoline percentage includes "Flexible (Gasoline/Ethanol)" fuel types.

69. There is no reason to believe that owners of gasoline-powered vehicles have the same views about the importance and value of meeting emission standards as owners of diesel powered vehicles and neither Mr. Weir nor Mr. Gaskin has substantiated this assumption. As noted above, the respondents to Mr. Gaskin's survey would have been willing to pay more for gasoline engines than diesel engines, which is contrary to how gasoline and diesel engines were actually priced by VW and Audi. Indeed, Mr. Gaskin cannot prove that **any** of the people responding to his survey were TDI owners and lessees. Since we cannot identify which type (gasoline/diesel) of engine is in the vehicles owned by Mr. Gaskin's survey respondents, Mr. Gaskin's survey cannot be reliably used for any purpose in relation to Plaintiffs, who by definition chose to purchase TDI vehicles.

8.7 Sample representativeness

70. In addition to the overarching problem of using the wrong population (including consumers who selected gas models), Mr. Gaskin has also not shown that his sample is adequately representative in other ways. Mr. Gaskin has a small sample of consumers to represent the larger class (which includes the named Plaintiffs). The idea here is that, if the sample is representative of the proposed class, then results based on the sample can be projected to the larger class (or what statisticians call the population). Mr. Gaskin does not provide any discussion of how he ensures that his sample is representative. Among others, Allenby and Rossi (2019) discuss this issue at length and conclude that it is the responsibility of whomever sponsors a survey to provide affirmative evidence of representativeness.[84] It should be emphasized that Mr. Gaskin uses what statisticians call a "convenience" sample of consumers, constructed by screening respondents from an internet panel.[85] Internet panels are not representative samples of the U.S. population. These are merely panels of people who agree to take surveys for compensation. It is well known that internet panels can be biased in their composition with an over representation of certain gender, age, and income groups.[86] Because the internet providers start with a non-representative sample, it is important to inspect your given sample for representativeness. Representativeness must be asserted relative to consumer preferences

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[84] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, pp. 168–170. *See* also Diamond, S. H. (2011), "Reference Guide on Survey Research," in *Reference Manual on Scientific Evidence*, 3rd ed., Washington, DC: The National Academies Press, 359–423, p. 380 ("Identification of a survey population must be followed by selection of a sample that accurately represents that population.").
[85] For a discussion, see Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 169.
[86] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 169.

for vehicle features. It is not enough to assert demographic representativeness of the sample.[87]

71. Because Mr. Gaskin did not establish representativeness of his sample, his survey cannot be used as a reliable basis for Mr. Weir's damage calculations. As an example, I can demonstrate that Mr. Gaskin's sample is highly skewed toward female respondents and, therefore, it is not representative. Only 42.5 percent of his final sample is male,[88] contrary to information from market research surveys of new purchasers of cars indicating that VW TDI purchaser are overwhelmingly male.

72. Males constitute 78% of Jetta TDI buyers,[89] 77% for Passat TDI,[90] and 70% for Golf TDI.[91] Hence, Mr. Gaskin's sample is heavily skewed towards females, and is not representative of TDI purchasers. Mr. Gaskin did not inquire of his sample respondents whether or not they owned a relevant TDI diesel which is the subject of this litigation. The fact that his sample is skewed toward a majority female respondents and he did not properly screen to only diesel purchasers, strongly suggests that Mr. Gaskin's sample contains few actual TDI purchasers.

8.8 Sample Size

73. If a conjoint survey is designed properly and without any biases, then the issue becomes how many respondents are required to ensure that sampling error is held to an acceptable minimum.[92] I have already demonstrated that Mr. Gaskin used a non-standard conjoint

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[87] For a discussion, see Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192.

[88] Gaskin Production ("Exhibit M_Screener Data Listing.xlsx").

[89] "Volkswagen Brand Customer Profiles, FY 2014," Volkswagen, VW-VAMDL-02457185–335 at 233.

[90] "Volkswagen Brand Customer Profiles, FY 2014," Volkswagen, VW-VAMDL-02457185–335 at 248..

[91] "Volkswagen Brand Customer Profiles, FY 2014," Volkswagen, VW-VAMDL-02457185–335 at 290..

[92] See discussion in Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, pp. 174–175.

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with choice tasks that are far from what consumers experience when they purchase vehicles. Moreover, Mr. Gaskin provides no evidence that his results are not biased due to lack of representativeness of his sample. For the sake of completeness, I will continue and review Mr. Gaskin's claims regarding sample size.

74. Mr. Gaskin is wrong when he claims, without explanation, that a "sample size of 200 respondents is more than sufficient for making scientifically valid conclusions."[93] Mr. Gaskin ignores that using conjoint to estimate WTP is more demanding of sample size than generic conjoint applications.[94] It is well known by expert statisticians that it is not possible to determine an adequate sample size prior to a conjoint survey administration.[95] The technical reason for this is that the information matrix for a conjoint model is a function of unknown parameters. Simple statistical estimates such as a sample proportion (e.g. the fraction of voters in favor of any candidate in any election) do have sample size formulas that can be used to guide the choice of sample size. For a sample proportion, a relatively small sample size may suffice. However, Mr. Gaskin uses a very complex model to estimate the conjoint parameters. Moreover, he undertakes complex calculations using the conjoint partworth estimates that are based on his survey data.

75. Mr. Gaskin's only basis for his incorrect assertion is a citation to chapter 7 of Orme (2014).[96] In this chapter, Orme provides a formula which provides a "guideline" on sample size. However, Orme is himself highly critical of this formula, calling it a "rule-of-thumb." Orme is correct that this formula was not derived from any rigorous statistical

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[93] Gaskin Report, ¶ 44.

[94] Gaskin Report, ¶ 44.

[95] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 175.

[96] Gaskin Report, ¶ 44, citing Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, pp. 68–69.

analysis but simply a rough and ready "rule-of-thumb." Orme goes on to caution that this "rule-of-thumb" is highly inaccurate and provides an underestimate of an adequate sample size. "Over the years, we have become concerned that practitioners use Johnson's rule-of-thumb to justify sample sizes that are too small."[97] Orme is exactly correct on this.

76. The formula referenced by Mr. Gaskin[98] does not have any basis in either experience with conjoint studies or statistical analysis and is therefore unreliable. To illustrate this, I will evaluate the formula for Mr. Gaskin's study. Mr. Gaskin has 3 choice alternatives (a = 3, note this does not include the outside good), a maximum of 5 attribute levels (for price, this is the "c" parameter). Mr. Gaskin has 12 choice tasks. Using the "rule-of-thumb" formula on the bottom of page 64 of Orme, any sample of size (500*5)/(12*3) = 70 or greater would be adequate according to Mr. Gaskin. This is an absurd result which shows how completely wrong this "rule-of-thumb" is. In fact, Allenby and Rossi (2019 and 2014) discuss this very issue in the computation of WTP (which is what Mr. Gaskin is doing) and market prices (which is a much more complicated calculation) and state that sample sizes of 500-1000 are often inadequate.[99]

77. In summary, Mr. Gaskin's blanket and unsupported assertions regarding sample size render his opinions unreliable.

9. Lack of a margin of error

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[97] Orme, B. K. (2014), *Getting Started with Conjoint Analysis*, 3rd ed., Manhattan Beach, CA: Research Publishers LLC, p. 69.

[98] $\frac{nta}{c} \geq 500$ where n is the sample size, t is the number of choice tasks, a is the number of choices, and c is the maximum number of attributes.

[99] Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192, p. 175; Allenby, G. M. et al. (2014), "Valuation of Patented Product Features," *Journal of Law and Economics* 57, 3, 629–663, p. 660.

78. Mr. Gaskin has also violated a fundamental rule for the presentation of statistical evidence. Mr. Gaskin's ultimate calculation, and the only calculation which Mr. Weir uses, is a reduction in "market value" expressed as a percentage. Mr. Gaskin incorrectly claims that the "defeat device" caused an 8.5 percent reduction in market value. This 8.5 percent is based on complicated calculations performed on conjoint survey data. Any calculation based on data is called an estimator by statisticians. The resulting calculations are a statistical estimate. All statistical estimates contain sampling error. For example, if we were to take a small sample of U.S. adults and measure the proportion of that sample that has brown eyes, it would be irresponsible for a statistician to pretend that this estimate does not have sampling error. Mr. Gaskin's analysis is unreliable in this respect. He offers no discussion in his report regarding the sampling error which, by definition, would afflict his estimates of the percentage reduction in "market value."

79. All statistically derived estimates must be accompanied by a margin of error calculation. [100] In fact, an estimate without such a margin of error is useless as we cannot evaluate the quality of the estimate. If the margin of error in Mr. Gaskin's 8.5 percent reduction in WTP is also 8.5 percent or higher, then we don't even know if there actually was any reduction of WTP. The data would be consistent with either no reduction or a very large reduction. Typically, we evaluate the quality of a statistical estimate by the ratio of the

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[100] "[A]n estimate based on a sample will differ from the exact population value, because of random error. The standard error gives the likely size of the random error. If the standard error is small, random error probably has little effect. If the standard error is large, the estimate may be seriously wrong." *See* Kaye, D. H., and D. A. Freedman, "Reference Guide on Statistics," in *Reference Manual on Scientific Evidence*, 3rd ed., Washington, DC: The National Academies Press, 211–302, p. 246. "Experts who collect survey data, along with the professions that rely on those surveys, may differ in some of their methodological standards and principles. An assessment of the precision of sample estimates and an evaluation of the sources and magnitude of likely bias are required to distinguish methods that are acceptable from methods that are not." *See* Diamond, S. H. (2011), "Reference Guide on Survey Research," in *Reference Manual on Scientific Evidence*, 3rd ed., Washington, DC: The National Academies Press, 359–423, p. 364, footnote 16.

estimate to the margin of error. In the example that I just gave, the relative sampling error

is 100 percent or greater. This would be an unacceptable relative error.

80. At the very least, Mr. Gaskin's estimates are unusable without a valid method for

computing a margin of error.

10. Non-Uniform Price Premia Across Different Years, Makes, and Models of Vehicles

81. Mr. Weir's calculation is also flawed on a fundamental level. Mr. Weir opines that any

premium calculation can be expressed as a percentage (e.g. 8.5 percent) and that this

percentage can be applied in a uniform fashion to all years, makes and models of vehicles

in this matter. This is purely an assumption which is not supported by any data or

economic argument. In fact, Mr. Gaskin's own attempts to compute a percentage directly

refute this assumption made by Mr. Weir. As I have shown in Section 7.3 above, this

percentage is highly sensitive to the base price used by Mr. Gaskin in his WTP calculations.

For example, a base price of $16,000 results in an alleged premium of 60.5 percent.

82. Mr. Gaskin's own survey data can also be used to directly refute Mr. Weir's assumption of

a constant percentage premium over all models. For example, Mr. Gaskin's WTP

percentage is only 6.6 percent for the sub-sample of Passat owners and 5.7 percent for the

sub-sample of VW Beetle owners in Mr. Gaskin's survey.[101]

83. The key question for the purposes of a proper WTP analysis is whether or not consumer

preferences for compliance with EPA emission standards vary across a widely different

set of vehicles, from relatively inexpensive utilitarian VW cars to luxury Audi models. Mr.

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[101] These values are derived by replicating Mr. Gaskin's calculations while restricting the respondents included in the simulator to only those who answered that they owned (1) Passats, and (2) Beetles. *See* Gaskin Production ("Exhibit N_Conjoint Data Listing (nvvw_data).xlsx", "nvvw.ssi") and "Workpaper 5 - Gaskin Exhibit K - By Model.xlsx".

Weir has not shown his assumption that consumer preferences remain the same across all vehicle makes and models is correct. Consumer preferences vary widely across makes and models and, without evidence to the contrary, Mr. Weir's damages calculations are based on an invalid assumption.

11. Conclusions

84. Neither Mr. Weir nor Mr. Gaskin have produced a reliable method by which damages for the Plaintiffs in this case could be determined. Mr. Weir endorses a theory of damages which is the reduction of "market value" associated with the failure to disclose the "defeat device." In simple terms, Mr. Weir suggests that class members "overpaid" for their vehicles because the marketplace was not aware of the "defeat device." He offers two damage calculations: (a) a percentage reduction in "market value" provided by Mr. Gaskin and simply applies this percentage to the prices actually paid by class members; (b) he offers, without explanation or justification, an alternative damage method where he computes an "offsetting" quantity to the result of simple application of a percentage reduction.

85. The validity of the Weir-Gaskin damage approach hinges on whether or not they have a valid method to infer what market prices would prevail in the counterfactual, "but-for" world in which the "defeat device" was known in the marketplace. While Mr. Weir does observe the actual prices paid by Plaintiffs, he does not observe or demonstrate the market price that would prevail in the "but-for" world. Thus, the entire validity of the Gaskin-Weir analysis is dependent on their ability to estimate this "but-for" market price. Nothing in Mr. Gaskin's conjoint survey or analysis provides that price. A conjoint survey is only a measurement of demand – it does not provide any information about supply. Mr. Gaskin has clearly explained that he will compute the reduction in what he calls "market value" as

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that reduction in price necessary to equate the demand for a specific hypothetical vehicle with disclosure of the "defeat device." This is the definition of the reduction in WTP on the basis of disclosure. It is not, nor can it ever be, a reliable measure of market price.

86. Therefore, the Gaskin-Weir methodology is invalid and unreliable to compute the market price in the "but-for" world. Both Mr. Weir and Mr. Gaskin claim, incorrectly, to have undertaken "supply considerations." The only information that they claim is evidence of "supply consideration" is the prices actually paid and the number of vehicles actually sold. This is not sufficient to compute a market price in a different, hypothetical world in which the "defeat device" is known to the marketplace, because the change in the seller's willingness to sell would affect the price and quantity of vehicles available to the market. And, as I show above, Mr. Gaskin's survey does not use market prices for VW and Audi vehicles consistent with real-world prices.

87. In his report, Mr. Gaskin only reported one "market value" reduction estimate of 8.5 percent. He does not reveal that this percentage in only one of ten different percentages he computed. These nine other numbers range as high as 60.5 percent. The extraordinarily wide range of these numbers shows the profound unreliability of Mr. Gaskin's survey and method even for the task of computing a reduction in Willingness To Pay.

88. Finally, Mr. Gaskin erred in the design of his survey in many ways, including (most egregiously) by including owners of vehicles with gasoline engines even though the issue in this matter only applies to certain diesel-powered vehicles. This flaw and the others described in my report renders his analysis, and any conclusions drawn by Mr. Weir based on Mr. Gaskin's survey, unreliable and irrelevant to this case.

Respectfully submitted,

Peter E. Rossi

March 13, 2020

Appendix A

CURRICULUM VITAE
PETER E. ROSSI

Date of Birth: November 25, 1955
Citizenship: United States

Business address

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110 Westwood Plaza, B5.15
Los Angeles, CA 90095

email: perossichi@gmail.com

Education

B.A., 1976, Oberlin College (Mathematics and History).
M.B.A., 1980, Graduate School of Business, The University of Chicago (Management Science).
Ph.D., 1984, Graduate School of Business, The University of Chicago (Econometrics).
Dissertation Title: "Specification and Analysis of Econometric Production Models."

Fellowships, Honors, and Grants

Phi Beta Kappa Zeta of Ohio, elected 1975.

University of Chicago Fellowship, 1978-1980. G.M. Fellowship, University of Chicago, 1980-1981.

Kellogg Research Chair, Northwestern University, 1983-84.

1987 Savage Prize for best dissertation in Bayesian Econometrics and Statistics.

I. B. M. Scholar, Graduate School of Business, University of Chicago, 1988-89.

Bozell, Jacobs, Kenyon and Eckhardt Faculty Scholar, Graduate School of Business, University of Chicago, 1994-95.

Elected Fellow, American Statistical Association, June 1998.

1999 Mitchell Prize for Best Applications Paper in Bayesian Statistics for "Estimating Price Elasticities with Theory-based Priors (with A. Montgomery),"
awarded by American Statistical Association, Bayesian Statistics Section.

2000 Arthur Kelly Faculty Prize, GSB, U of Chicago, (awarded bi-annually for service to school).

"Bayesian Analysis of Stochastic Volatility Models" named one of most influential articles in twentieth anniversary issue of *Journal of Business and Economic Statistics* (2002).

Named Fellow, *Journal of Econometrics*, 2001.

2010 Long-term Impact Award, *Marketing Science Society* (with Greg Allenby).

2016 Dean's Prize for Exceptional Faculty Mentorship of PhD Students.

2019, Elected INFORMS Society of Marketing Fellow.

Areas of Research Interest

Marketing: Brand Choice, Target Marketing, Price Promotions, Consumer Heterogeneity, Couponing, Search Theory, Direct Marketing

Econometrics: Hypothesis testing in systems of equations, non-nested hypothesis-testing procedures, Bayesian methods, limited dependent variable models, non-parametric time series methods.

Microeconomics: demand analysis applied to individual consumer expenditure data.

Positions Held

Analyst, Abt Associates Inc., 1976-1977.
Consultant, SRI International Inc., 1978.
Research Assistant, University of Chicago, 1979-1981.
Lecturer in Managerial Economics, Kellogg Graduate School of Management, Northwestern University, 1981-1983.
Assistant Professor of Managerial Economics, Kellogg Graduate School of Management, Northwestern University, 1983-86.
Visiting Assistant Professor of Econometrics and Statistics, Graduate School of Business, The University of Chicago, 1985-1986.
Assistant Professor of Econometrics and Statistics, Graduate School of Business, The University of Chicago, 1986-1990.
Associate Professor of Econometrics and Statistics, Graduate School of Business, The University of Chicago, 1990-1994.
Professor of Marketing, Econometrics and Statistics, Graduate School of Business, University of Chicago, 1994-1997.
Joseph T. and Bernice S. Lewis Professor of Marketing and Statistics, Booth School of Business, University of Chicago, 1997-2010.
James Collins Professor of Marketing, Statistics, and Economics, Anderson School of Management, UCLA, 2010-present.

Consultant for RFG Options, Harris Bank, Hull Trading, GE Capital, Ernst and Young, KPMG Peat Marwick, Abbott Labs, Department of Defense, Booz Allen and Hamilton, Arthur Andersen, Kestenbaum and Company, Oliver, Wyman and Co.

Expert Witness for various legal proceedings involving statistical analysis, survey sampling, marketing and pricing, anti-trust, valuation of lost personal and business income, franchise rights, patent and trademark infringement, bio-statistics and job discrimination, and trademark infringement. Law firms involved include: Ross and Hardies, Rudnick and Wolfe, Seyfarth and Shaw, Sidley and Austin, Winston and Strawn, Arnold, White and Durkee, Hinshaw and Culbertson, Kirkland and Ellis, Cravath, Swaine and Moore, Mayer, Brown and Platt, Howrey, Bryan Cave LLP, Jones Day, Latham and Watkins, WilmerHale.

Publications: (click on links below to open full article in pdf)

Google Scholar Cites: 18,500+, H-index: 50 as of 9/19. Google Scholar Citations.

Software

R package, bayesm, downloaded more than 130,000 times from RStudio mirror alone in the year ending 7/30/19.

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Modelling Stock Market Volatility: Bridging the Gap to Continuous Time (1996), San Diego: Academic Press (editor).

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Available on SSRN

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"Bayesian Econometrics" (2018)) with G. Allenby in *Handbook of Marketing Analytics*: Methods and Applications in Marketing Management, Public Policy, and Litigation Support, N. Mizik and D. Hanssens, eds, Edward Elgar Publishing.

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Discussions

"Both Network Effects and Quality are Important" (2009) Journal of Marketing Research, XLVI, April.
"Discussion: 'Statistical Properties of Generalized Method of Moments Estimates Using Financial Market Data'" (1986) *Journal of Business and Economic Statistics*, 4, 417-419.

PhD Students

Eric Gyhsels (84), Professor of Economics, University of North Carolina
Greg Allenby (88), Kurtz Professor of Marketing, Ohio State University
Eric Jacquier (91), Associate Professor of Finance, HEC Montreal
Byung-Do Kim (92), Professor of Marketing, Seoul National University
Alan Montgomery (94), Associate Professor of Marketing, CMU
Peter Boatwright (98), Associate Professor of Marketing, CMU
Andrew Ainslie (98), Professor of Marketing, Simon School of Business, University of Rochester
Renna Jiang (09), Assistant Professor of Marketing, UC Davis

Professional Activities

Associate Editor, *Journal of Business and Economic Statistics* 1986-1988
Associate Editor, *Journal of Econometrics*, 1987-1995.
Member, Editorial Board *Marketing Science*, 1994-2003.
Member, Editorial Board, *Journal of Marketing Research*, 1998- .
Associate Editor, *Journal of American Statistical Association* (applications section), 1995–2001.

Founding Editor (with Rajiv Lal), *Quantitative Marketing and Economics*, *2000-2010.*

Senior Editor*, Marketing Science, 2015-2018.*

Chair, Business and Economics Section, American Statistical Association, 1995.
Seminar Leader, NBER/NSF Seminar on Bayesian Inference in Econometrics, 1995-1998.
Member, Savage Award Committee, ASA, 1995-2000.
Member, Advanced Research Forum Program Committee, AMA, 2000-2003

Referee for *Econometrica*, *Journal of Econometrics*, *Journal of Political Economy*, *Journal of the American Statistical Association*, *American Statistician*, *Econometric Theory*, *Journal of Applied Econometrics*, *Journal of Business*, *Marketing Science*, *Review of Financial Studies*, *Review of Economics and Statistics*, *Management Science*, *Journal of Marketing Research*, J*ournal of the Royal Statistical Society*.

Service Activities

Anderson/UCLA

Vice-Chair, FEC (faculty policy committee advisory to Dean), 2013-2014.
Chair, Staffing Committee, 2012-13.
Chair, MFE Review Committee, 2012.
Member, Committee to propose and develop MSBA (MS in Business Analytics) degree, 2015- .

Chicago Booth

Director, Strategic Marketing Management (short course exec ed program), 96-09.
Chair, Deans Reappointment Committee, 05.
Elected member, Dean's Search Committee, 96.
Elected member, Dean's Policy Committee, 96-09.
Chair of Recruiting, Marketing Group, 96-00, 01-03, 05-09.
Course Scheduler, Marketing Group, 96-00.
Founder, Kilts Center for Marketing

Appendix B

Prior Testimony (last four years)

2016   In re Anthem, Inc. Data Breach Litigation, *US District Court, Northern District of California, San Jose Division.* Deposition testimony.

2016   Alvin Todd, et al v. Tempur-Sealy, US District Court, Northern Division of California. Retained by Plaintiffs. Deposition testimony.

2016   Dzielak et al v. Whirlpool Corporation, US District Court, District of New Jersey. Deposition testimony.

2017   Dyson v. SharkNinja, US District Court, Northern District of Illinois, Eastern Division. Deposition testimony.

2017   The People of the State of California acting by and through Orange County District Attorney Tony Rackauckas v. General Motors, LLC, US District Court, Central District of California. Deposition testimony.

2017   In re GM LLC Ignition Switch Litigation, US District Court, Southern District of NY. Deposition testimony.

2018   USA v. ATT/Time Warner, US District Court, Washington DC. Deposition and trial testimony.

2018   In re Navistar Maxxforce Engines Mktg., Sales Practices and Products Liability Litigation, *US District Court, Northern District of Illinois, Eastern Division.* Deposition testimony.

2018   In Premera Blue Cross Customer Data § Security Breach ligitation, *US District Court, Oregon.* Deposition testimony.

2018   Blitz v. Monsanto, US District Court, Western District of Wisconsin. Deposition testimony.

2018   Nestle USA v. Crest Foods, US District Court, Central District of California. Deposition testimony.

2019   Riley Johannessohn et al. v. Polaris Industries, Inc., US District Court, District of Minnesota. Deposition testimony.

2019   Nestle SA v. Crest Foods, International Arbitration. Testimony.

2019   Stockinger et al. v. Toyota Motor Sales, U.S.A., Inc., US District Court, Central District of California. Deposition testimony.

Appendix C

Documents Considered List

Academic Articles

- Allenby, G. M. et al. (2014), "Economic Valuation of Product Features," *Quantitative Marketing and Economics* 12, 4, 421–456.

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- Cattin, P. and D. R. Wittink (1982), "Commercial Use of Conjoint Analysis: A Survey," *Journal of Marketing* 46, 3, 44–53.

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- Allenby, G., N. Hardt, and P. Rossi (2019), "Economic Foundations of Conjoint Analysis," in *Handbook of the Economics of Marketing*, Volume 1, J. Dube and P. E. Rossi eds, Amsterdam, Netherlands: Elsevier, 151–192.

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Expert Reports and Supporting materials

- Declaration of Colin B. Weir and supporting materials, February 14, 2020.

- Expert Report of Steven P. Gaskin and supporting materials, February 14, 2020.

Legal Documents

- First Amended Class Action Complaint, *Jennifer Nemet et al., v. Volkswagen Group of America, Inc. et al.*, Docket No. 3:17-CV-04372-CRB, November 2, 2018.

Bates Stamped Documents

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Appendix D

Mr. Gaskin's Reduction in Market Value is Change in WTP

Mr. Gaskin uses a conjoint "market simulation" to determine the change in price necessary to equate the sales of two VW products that are identical in all features except the presence of the "defeat device." He calculates the reduction in "price" required to equate the sales (market share) of the vehicle with the "defeat device" with the vehicle without the "defeat device."

To simplify this discussion, I will assume a linear price term; all the results here go through with a piece-wise linear price function.

According to the logit model, the expected market share for products depends on the conjoint partworths and the levels of product attribute. Mr. Gaskin considers two products whose conjoint utility can be written as follows:

1. Utility of product without the "defeat device": $U_1 = g + b_p P$

2. Utility of product with the "defeat device": $U_1 = g + d_{defeat} + b_p P_{defeat}$

Here, d_{defeat}, is the partworth for "defeat device" (presumably negative). P is the price without "defeat device" and P_{defeat} is the price with the "defeat device."

Equating the expected market share for these two products, we can solve for the change in price.

$$\frac{e^{g + d_{defeat} + b_p P_{defeat}}}{e^{g + d_{defeat} + b_p P_{defeat}} + e^{g + b_p P}} = \frac{e^{g + b_p P}}{e^{g + d_{defeat} + b_p P_{defeat}} + e^{g + b_p P}}$$

$$\Rightarrow P_{defeat} = P - \frac{d_{defeat}}{b_p}$$

$$or\ \mathrm{D}P = -\frac{d_{defeat}}{b_p}$$

Thus, Mr. Gaskin's measure is nothing more than a change in WTP. With many consumers,

this measure simply becomes a measure of average WTP.

Appendix E

Misleading References to "Market" Concepts in Gaskin/Weir Reports

In many parts of their reports, Mr. Gaskin and Mr. Weir claim that conjoint can estimate a "market value," "relative market value," a "difference in market value," or a "reduction in value" for at-issue vehicles. As described in Section 5 of my report, conjoint analysis can, at best, measure willingness to pay, not market prices, and Mr. Gaskin's conjoint analysis cannot reliably estimate any market value, let alone an alleged reduction in market values for vehicles.

I list below all the instances in which the Gaskin Report and the Weir Report make such claims.

Gaskin Report:

Paragraph 11: "[t]he analysis I ran estimates the **relative market values** (measured in dollars and percentage terms) of Survey Vehicles containing the Defeat Device compared with those same vehicles without the Defeat Device."

Paragraph 12: "[b]ased on the methodology described in this report, my conclusion is that the **market value of the Survey Vehicles**, at the time and point of first purchase, was 8.5% lower than the **market value** would have been in those same vehicles without the Defeat Device."

Paragraph 14: "[t]he general idea behind conjoint analysis is that the market value for a particular product is driven by features, or descriptions of features, embodied in that product, and that survey based statistical analysis **can be used to derive that market value**."

Paragraph 16: "CBC allows us to determine the **relative market values** (measured in dollars and percentage terms) of Survey Vehicles containing the Defeat Device, compared with those same vehicles without the Defeat Device: in other words, the **difference in the market value,** at the point of purchase or lease, of a Survey Vehicle with a diesel engine that only meets NOx emission standards during testing, but not during normal driving, compared with the value of an otherwise identical vehicle with a diesel engine that meets NOx emission standards during both testing and normal driving.

Paragraph 23: "Including price as one of the measured features in the conjoint analysis allows us to determine the **value** (be it negative or positive) **that the market places on changes in features**. A **reduction in market value** can be calculated as the price reduction needed to compensate consumers in the marketplace for the loss of a feature or a change to a less desirable level of a feature. Similarly, we can calculate a **market price premium** as the additional price consumers in the marketplace would pay for the inclusion of a feature or a more desirable level of a feature... Because CBC is based directly on consumer choices and the actual range of market prices, it is, in my opinion, an appropriate method to determine the question presented for this analysis: namely, to identify the **relative market value** of

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Survey Vehicles containing the Defeat Device compared with the **market value** of those same vehicles without the Defeat Device."

Paragraph 24: "It is my opinion, based in part on the Weir Report, that the conjoint methodology set forth in this report **accounts for appropriate market supply-side factors**, including in the following ways: (1) the price ranges used in the survey reflect the actual market prices that prevailed during the Class Period; and (2) the quantity of Survey Vehicles used (or assumed) in the damages calculations reflects the actual quantity of such vehicles sold during the Class Period (the number of Survey Vehicles sold being fixed as a matter of history)."

Paragraph 56: "[T]hese models are appropriate to use when making the **market value comparison calculations** in this report."

Paragraph 56: "I used the **Market-Based Method** to determine the relative market value of the Survey Vehicles with and without the Defeat Device. The Market-Based Method uses the HB partworths to **simulate the market reaction** to choice sets of products and prices."

Paragraph 59: "The **Market-Based Method** predicts **how the market would react** to the disclosure of the Defeat Device by examining consumers' choice probabilities for (a) the vehicles already purchased (and which thereby contained the Defeat Device), as compared to (b) otherwise identical vehicles that did not contain the Defeat Device. When determining the **difference in market value** between those two categories of vehicles, I held all other features (except price) constant at specific levels ... These utilities, in turn, combined with a decision rule (i.e., Randomized First Choice), were used in a conjoint simulator to calculate the **difference in market value** attributable to the Defeat Device. ... I found the price such that half of the market (as represented by the data from all of the respondents in my analysis) chose the vehicle with the Defeat Device and half of the market chose the vehicle without the Defeat Device (i.e.,
each one had a market share of 50%). The difference in market value equals this difference between the two prices, which represents the amount necessary to compensate for the presence of the Defeat Device. … Among the price differences obtained at the different levels of starting prices, the smallest represents the most
conservative estimate of the **difference in market value** for the vehicle with the Defeat Device."

Paragraph 60: "[T]he Market-Based Method estimates that the **difference in market value** due to a change from 'Diesel engine that meets NOx emission
standards during both testing and normal driving' to 'Diesel engine that only meets NOx emission standards during testing' is $3,415.19 per vehicle."

Paragraph 61: "These dollar values were then expressed as a percentage of the highest price available in the survey to give the **difference in market value** on a percentage basis. Using the highest price … gives the lowest percentage d**ifference in market value.** … the most conservative percent **difference in market value** is calculated by taking the smallest dollar value for the **difference in market value** and dividing it by the highest price in the survey ($40,000). The **difference in market value** due to a change from "Diesel engine that meets

NOx emission standards during both testing and normal driving" to "Diesel engine that only meets NOx emission standards during testing" is 8.5% ($3,415.19/$40,000)."

Paragraph 62: "The analysis I ran **estimates the relative market value** (measured in dollars and percentage terms) of Survey Vehicles containing the Defeat Device compared with those same vehicles without the Defeat Device. … the analysis determines **the relative market value**, at the time and point of purchase or lease, of a Survey Vehicle with a "Diesel engine that only meets NOx emission standards during testing," but not during normal driving, compared with an otherwise identical vehicle with a "Diesel engine that meets NOx emission standards during both testing and normal driving."

Paragraph 63: "… my conclusion is that the **market value** of the Survey Vehicles, at the time and point of first purchase, was 8.5% lower than the **market value** would have been in those same vehicles without the Defeat Device."

Weir Report:

Paragraph 10: I propose the use of conjoint analysis to calculate any **Overpayment Damages** (wherein consumers would receive back a **portion of the price** they paid that **reflects the reduction in value** of the Vehicles at the point of purchase that is solely attributable to Defendants' conduct… ."

Paragraph 13: "Conjoint analysis … permits an economist to analyze the **value** of various product attributes.   Conjoint analysis can be used to **determine market valuation/**attribute information for a given product or attribute."

Paragraph 22: "The Gaskin Declaration describes how conjoint analysis has been used to determine **the reduction in economic value at the point of purchase** or lease resulting from the Defeat Device."

Paragraph 24: "Mr. Gaskin measures the **reduction in economic value** … caused by the Defeat Device"

Paragraph 27: "Mr. Gaskin's conjoint survey is properly designed to measure the **reduction in economic value** of the Vehicles at the time and point of first sale or lease as a result of the Defeat Device."

Paragraph 28: "Mr. Gaskin considered and accounted for supply-side factors in his conjoint design and analysis."

Paragraph 29: "I **have also considered supply-side factors** in my damages framework. First, unlike in a Lanham Act or intellectual property litigation where a but-for quantity of sales may need to be determined, in this litigation, the historic number of units sold is a fact (as I have discussed above) and in this litigation, it would be antithetical to the reality of the actual Class purchases and leases to suggest that the quantity supplied be anything other than the actual number of units sold by Defendants and purchased or leased by Class members."

Paragraph 32: "I worked closely with Mr. Gaskin to ensure that his survey was appropriately designed to **measure the true difference in economic value** at the point of purchase or lease solely attributable to the Defeat Device."

Paragraph 35: "Another important **supply-side factor** that Mr. Gaskin and I discussed was the fact that the quantity of the Vehicles supplied is a known quantity, and fixed as a matter of history - a fact which **Mr. Gaskin accounts for in his market simulations."**

Paragraph 47: "Mr. Gaskin has identified a conservative **reduction in economic value** of approximately 8.5% per vehicle."